VOLUME 1 JUNE 1984 NUMBER 1

# journal of oilseeds research

PUBLISHED BY
INDIAN SOCIETY OF OILSEEDS RESEARCH
DIRECTORATE OF OILSEEDS RESEARCH
RAJENDRANAGAR, HYDERABAD-500 030
INDIA

# THE INDIAN SOCIETY OF OILSEEDS RESEARCH



---


**Journal of Oilseeds Research** is the official organ of the Indian Society of Oilseeds Research published half yearly. It is sent free to the members but for others the annual subscription is Rs 100=00 in India and $ 20=00 in other countries, post free by surface mail. Subscription should be sent with an order to the General Secretary, The Indian Society of Oilseeds Research, Directorate of Oilseeds Research, Rajendranagar, Hyderabad 500 030, India.

DOR-323

# Journal of Oilseeds Research

VOLUME 1 JUNE 1984 NUMBER 1

## CONTENTS



### SHORT COMMUNICATIONS

J. Oilseeds Res. 1(1984) : 1-9

# Effect of date of sowing on yield and yield attributing characters of taramira

**P. L. Maliwal, R. P. Jangir, and S. L. Sharma**
Department of Agronomy, SKN College of Agriculture, Jobner, Rajasthan, India

## ABSTRACT

An experiment was conducted with taramira for three years (1980-82) at Jobner (Rajasthan) to study the effect of sowing dates on taramira varieties. October 10, sowing resulted in the highest yield of 1060.67 kg/ha. Among the ancillary characters of taramira, test weight (1000 grains weight), pods per plant and plant height were significantly higher when the crop was sown on September 25, which was closely followed by October 10. Days to maturity was also highest in September 25 sown crop but the plant population was lowest in this date and ultimately resulted lower yield as compared to October 10.

Among the varieties $T_{27}$ gave significantly higher yield over RTM-1 and RTM-2. Seeds/pod, plant height and days to maturity were also significantly higher in variety $T_{27}$ over RTM-1 and RTM-2. However, seeds/pod differed significantly only during the year 1980-81 and 81-82. Nevertheless, plant stand, test weight and pods per plant did not differ significantly among the varieties.

**Key words :** Taramira; *Eruca sativa*; Date of sowing

## INTRODUCTION

Taramira (*Eruca sativa* Mill.) is a most neglected crop of rapeseed and mustard group of winter oilseeds. It is always choosen for a piece of land, where only few dry land crops can be grown successfully. This crop is especially suitable for area with meagre or no irrigation facilities because of efficient root system to extract moisture from lower soil horizons (Singh and Sharma, 1976). The crop has almost been neglected by the agricultural scientists and practically no work has been done to date on this important crop. Usually, sowing of this crop is done any time from the month of September to December depending on the rains or conserve moisture present in the soil. Due to lack of knowledge about the adequate sowing time, the farmers can not reap the required yield of the crop. Therefore, the present investigation has been undertaken to study the effect of planting dates on different varieties of taramira.

---

Received for publication on October 28, 1983

## MATERIALS AND METHODS

Field experiment was conducted at the Agronomy farm, College of Agriculture, Jobner (Rajasthan) for three successive winter seasons of 1980-81, 1981-82 and 1982-83. The soil of the experimental plot was sandy loam in texture having adequate drainage with low water holding capacity. The soil of the experimental field was alkaline and organic carbon was 0.16% to 0.26%. The soil was very low in N content (0.2 to 0.3%), low in available $P_2O_5$ (0.003 to 0.005%) and medium in $K_2O$ (0.20 to 0.35%) content. The treatments consisted of six dates of sowing viz., September 25 ($D_1$), October 10 ($D_2$), October 25 ($D_3$), November 9 ($D_4$), November 24 ($D_5$), and December 9 ($D_6$) and three varieties viz., RTM-1, RTM-2 and T-27. The experiment was laid out in split plot design with dates of sowing in main plot and varieties in subplots, replicated four times. A common dose of 30 kg N and 20 Kg $P_2O_5$ per hectare was drilled at the time of sowing. A net plot size of 5 m × 3 m was kept accommodating 10 rows spaced 30 cm apart with an intra row spacing of 10 cm. In addition to pre-sowing irrigation one or two life saving irrigations were applied at the critical stages of the crop.

## RESULTS AND DISCUSSION

**Sowing dates :**

A perusal of the data in Table 2 reveals that the dates of sowing has significant effect on the seed yield of taramira during all the three subsequent years. The highest grain yield (1060.67 kg / ha) has been observed in $D_2$ date of sowing treatment which was closely followed by $D_1$ and $D_3$ dates of sowing where the mean yield was observed to be 927.74 kg/ha and 888.57 kg/ha respectively. Though the significant higher yield was observed under $D_2$ date of sowing treatment over $D_1$ and $D_3$ dates in the year 1981-82, the yield did not vary significantly in the years 1980-81 and 1982-83. The higher yield in $D_2$ date of sowing compared to $D_1$ date of sowing was due to more number of surviving plants present (Table 2). In $D_1$ date of sowing seedlings could not survive due to high temperature and high rate of evapotranspiration in the month of September (Table 1). The yield reduction in $D_1$ date of sowing due to low plant population in the year 1980-81 and 1982-83 might have been compensated due to more number of pods per plant and seeds per pod in $D_1$ date of sowing as compared to $D_2$ date, whereas during 1981-82 the yield could not be compensated to the same level and ultimately resulted into lower yield. Higher yield obtained in early sowings ($D_1$ and $D_2$) compared to late sowing dates might be due to the fact that the crop gets sufficient time for its growth under suitable climatic condition in comparison to late sowing.

Table 1 : Mean monthly weather data prevailing during growing seasons

| Month | 1980-81 Max. Temp. (°C) | 1980-81 Min. Temp. (°C) | 1980-81 Total Rain fall (mm) | 1980-81 Evaporation from U.S, Pan (mm/day) | 1980-81 Sun shine hrs/day | 1981-82 Max. Temp. (°C) | 1981-82 Min. Temp. (°C) | 1981-82 Total Rain fall (mm.) |
|---|---|---|---|---|---|---|---|---|
| September | 35.22 | 17.42 | 6.50 | 6.20 | 9.82 | 34.50 | 23.09 | 91.80 |
| October | 34.20 | 14.05 | Nil | 5.06 | 9.32 | 35.81 | 16.10 | Nil |
| November | 28.20 | * | Nil | 3.30 | 9.20 | 27.49 | 9.97 | 25.50 |
| December | 22.67 | * | 4.55 | 2.30 | 7.08 | 23.54 | 5.70 | Nil |
| January | 21.12 | * | 1.44 | 2.40 | 8.06 | 20.99 | 7.50 | 31.40 |
| February | 26.50 | * | Nil | 4.22 | 8.00 | 22.21 | 8.88 | 15.10 |
| March | 29.22 | * | 2.05 | 5.65 | 8.00 | 27.24 | 11.21 | 21.70 |
| April | 38.20 | 20.45 | Nil | 10.00 | 9.84 | 35.77 | 18.71 | 42.70 |

Table 1 (Contd,)

| 1981-82 Evaporation from U. S. Pan (mm/day) | 1981-82 Sun shine (hrs/day) | 1982-83 Max Temp. (°C) | 1982-83 Min Temp. (°C) | 1982-83 Total Rain fall (mm) | 1982-83 Evaporation from U. S. Pan (mm/day) | 1982-83 Sun shine hrs/day |
|---|---|---|---|---|---|---|
| 5.60 | 8.88 | 34.60 | 18.10 | 15.90 | 6.20 | 9.50 |
| 3.10 | 9.84 | 34.10 | 17.90 | 25.00 | 4.00 | 9.20 |
| 2.80 | 4.33 | 27.20 | 12.50 | 9.70 | 3.10 | 7.10 |
| 4.50 | 9.10 | 23.70 | 6.40 | 7.40 | 2.30 | 8.50 |
| 2.10 | 7.69 | 21.80 | 4.10 | 0.80 | 2.20 | 8.40 |
| 3.30 | 6.83 | 23.10 | 5.90 | 3.40 | 2.90 | 8.80 |
| 5.20 | 7.90 | 29.40 | 10.60 | Nil | 5.80 | 8.90 |
| * | 9.09 | * | * | * | * | * |

* Data not available

Table 2 : Seed yield, days to maturity and plant stand of taramira as **influenced** by different varieties and dates of sowing

| Treatment | Seed yield (kg/ha) | | | |
|---|---|---|---|---|
| | 1980-81 | 1981-82 | 1982-83 | Mean |
| Date of sowing | | | | |
| $D_1$ | 1006.41 | 993.87 | 782.87 | 927.74 |
| $D_2$ | 1006.62 | 1389.51 | 785.87 | 1060.67 |
| $D_3$ | 895.09 | 1001.71 | 768.92 | 888.57 |
| $D_4$ | 730.13 | 967.26 | 643.03 | 780.14 |
| $D_5$ | 574.36 | 800.59 | 480.85 | 618.60 |
| $D_6$ | 286.11 | 472.24 | 278.86 | 345.74 |
| SEm ± | 45.32 | 68.529 | 11.67 | — |
| CD 5% | 136.15 | 206.523 | 35.17 | — |
| CV(%) | 20.93 | 25.32 | 6.48 | — |
| Varieties | | | | |
| RTM-1 | 725.96 | 834.76 | 594.44 | 718.39 |
| RTM-2 | 736.96 | 953.93 | 616.27 | 769.05 |
| T-27 | 786.43 | 1023.93 | 669.47 | 823.28 |
| SEM ± | 17.11 | 22.722 | 11.32 | — |
| CD 5 % | 47.29 | 65.211 | 31.39 | — |
| CV(%) | 11.18 | 11.870 | 8.09 | — |

NS = Non-significant.

Table 2 : (Contd.)

| Days to maturity | | | | Plant stand (,000/ha) | | | |
|---|---|---|---|---|---|---|---|
| 1980-81 | 1981-82 | 1982-83 | Mean | 1980-81 | 1981-82 | 1982-83 | Mean |
| 154.42 | 156.58 | 157.91 | 156.30 | 270.7 | 294.95 | 285.66 | 283.77 |
| 150.42 | 150.42 | 152.91 | 151.25 | 357.3 | 329.73 | 289.94 | 325.65 |
| 148.42 | 148.25 | 148.83 | 148.50 | 341.1 | 325.68 | 306.27 | 324.35 |
| 142.67 | 142.42 | 143.00 | 142.69 | 346.8 | 325.18 | 306.44 | 326.14 |
| 137.83 | 137.33 | 136.91 | 137.35 | 349.5 | 329.90 | 289.83 | 323.07 |
| 129.42 | 129.92 | 130.75 | 130.03 | 345.7 | 327.62 | 294.33 | 322.55 |
| 0.92 | 0.60 | 0.90 | — | 11.5 | 3.43 | 7.50 | — |
| 2.76 | 1.81 | 2.60 | — | 34.6 | 10.34 | NS | — |
| 2.21 | 1.45 | 2.15 | — | 10.9 | 3.69 | 8.75 | — |
| 141.58 | 142.17 | 143.00 | 142.75 | 337.6 | 318.48 | 294.19 | 316.75 |
| 141.87 | 141.96 | 143.16 | 142.33 | 330.7 | 323.37 | 302.80 | 318.95 |
| 148.12 | 148.33 | 149.00 | 148.48 | 337.1 | 324.68 | 293.74 | 318.54 |
| 0.51 | 0.48 | 0.50 | — | 4.28 | 2.37 | 3.90 | — |
| 1.56 | 1.38 | 1.37 | — | NS | NS | NS | — |
| 1.77 | 1.64 | 1.73 | — | 6.26 | 3.61 | 6.43 | — |

NS = Non-significant

Table 3 : Effect of date of sowing and varieties on ancillary characters of taramira

| Treatment | Test weight | | | | Pods/plant | | | | Seeds/pod |
|---|---|---|---|---|---|---|---|---|---|
| | 80-81 | 81-82 | 82-83 | Mean | 80-81 | 81-82 | 82-83 | Mean | 80-81 |
| Date of sowing | | | | | | | | | |
| $D_1$ | 3.55 | 3.81 | 4.09 | 3.82 | 234.9 | 248.55 | 135.21 | 206.22 | 13.94 |
| $D_2$ | 3.60 | 3.92 | 3.66 | 3.73 | 158.8 | 237.38 | 129.35 | 175.18 | 13.10 |
| $D_3$ | 3.20 | 3.78 | 3.42 | 3.47 | 134.5 | 218.45 | 98.85 | 150.60 | 17.05 |
| $D_4$ | 3.15 | 3.70 | 3.32 | 3.39 | 103.2 | 223.68 | 64.03 | 130.30 | 17 57 |
| $D_5$ | 3.35 | 3.76 | 3.26 | 3.46 | 102.1 | 128.48 | 42.00 | 90.86 | 18.6S |
| $D_6$ | 3.59 | 3.59 | 3.16 | 3.45 | 67.1 | 103.30 | 41.73 | 70.71 | 18.27 |
| SEm ± | 0.0S | 10.14 | 0.13 | — | 5.69 | 11.78 | 2.04 | — | 0.70 |
| CD 5% | 0.24 | NS | 0.38 | — | 17.10 | 35.51 | 6.13 | — | 2.11 |
| CV(%) | 8.22 | 13.30 | 8.85 | — | 14.78 | 21.12 | 8.29 | — | 14.85 |
| Varieties | | | | | | | | | |
| RTM-1 | 3.50 | 3.86 | 3.57 | 3.64 | 113.3 | 195.22 | 84.65 | 131.09 | 16.22 |
| RTM-2 | 3.45 | 3.67 | 3.39 | 3.50 | 143.3 | 165.67 | 84.31 | 141.09 | 15.81 |
| T-27 | 3.27 | 3.75 | 3.50 | 3.51 | 143.6 | 189.12 | 86.62 | 139.78 | 17.29 |
| SEm ± | 0.053 | 0.064 | 0.06 | — | 3.15 | 7.72 | 2.04 | — | 0.47 |
| CD 5% | 0.146 | NS | NS | — | 8.70 | NS | NS | — | NS |
| CV (%) | 7.600 | 8.340 | 16.90 | — | 11.58 | 19.57 | 11.77 | — | 14.13 |

NS = Non-significant.

Table 3 : (Contd.)

| Seeds/pod | | | Plant height in cm | | | | Primary branches/plant | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 81-82 | 82-83 | Mean | 80-81 | 81-82 | 82-83 | Mean | 80-81 | 81-82 | 82-83 | Mean |
| 16.88 | 15.01 | 15.28 | 103.90 | 123.93 | 101.31 | 109.71 | 7.56 | 10.00 | 7.30 | 8.29 |
| 18.15 | 12.82 | 14.69 | 102.10 | 114.39 | 94.55 | 103.68 | 7.30 | 9.08 | 7.43 | 7.94 |
| 17.25 | 13.86 | 16.05 | 97.60 | 116.20 | 88.58 | 100.79 | 6.48 | 9.92 | 6.91 | 7.77 |
| 19.24 | 15.17 | 17.33 | 88.10 | 111.91 | 81.78 | 93.93 | 5.68 | 9.78 | 6.55 | 7.34 |
| 15.48 | 14.70 | 16.29 | 74.80 | 93.76 | 58.23 | 75.60 | 6.52 | 8.05 | 5.32 | 6.63 |
| 15.75 | 14.50 | 16.17 | 56.40 | 81.68 | 49.58 | 62.55 | 5.38 | 6.85 | 5.14 | 5.79 |
| 0.63 | 0.50 | — | 2.61 | 2.87 | 3.99 | — | 0.30 | 0.68 | 0.30 | — |
| 1.90 | 1.53 | — | 7.83 | 8.66 | 11.97 | — | 0.90 | 2.05 | 0.91 | — |
| 12.78 | 12.27 | — | 10.36 | 9.31 | 17.50 | — | 15.30 | 26.24 | 16.61 | — |
| 16.78 | 13.24 | 15.41 | 79.80 | 97.27 | 69.73 | 82.00 | 6.62 | 9.22 | 6.63 | 7.49 |
| 17.25 | 14.16 | 15.74 | 82.20 | 105.42 | 79.70 | 89.11 | 6.62 | 9.07 | 6.35 | 7.35 |
| 17.33 | 15.62 | 16.75 | 100.30 | 118.24 | 87.59 | 102.04 | 6.32 | 8.56 | 6.34 | 7.07 |
| 0.44 | 0.37 | — | 1.05 | 3.03 | 1.83 | — | 0.18 | 0.11 | 0.20 | — |
| NS | 1.03 | — | 2.91 | 8.98 | 5.05 | — | NS | 0.34 | NS | — |
| 12.70 | 13.04 | — | 5.92 | 7.98 | 11.40 | — | 13.89 | 6.29 | 16.61 | — |

Nevertheless, the late dates of sowing i.e. $D_4$, $D_5$ and $D_6$ reduced the seed yield drastically. The lowest yield was recorded to be 345.74 kg/ha in $D_6$ treatment, which comes out to about 67% reduction in yield over $D_2$ treatment. These results corroborate with the reported work of Rai *et al.* (1981) on mustard and experiments conducted on toria at Pantnagar and on toria and mustard at Ludhiana (Anon., 1981-82). Similarly Tordoric (1975) and Nordestgaard (1978) also reported that seed yields of winter rape were highest in early sowing. The reduction in the yield in $D_3$ date of sowing was mainly attributed to the shorter growth period at the disposal of the late sown crop as the time taken by the crop to mature, decreased with delay in sowing (Table 2). The number of pods per plant and test weight which ultimately constituted the grain yield seems to have been affected by the growth period which, inturn, was influenced by planting time.

The maximum plant height (109.71 cm), days to maturity (156.30), number of pods/plant (206.22), primary branches/plant (8.29) and test weight (3·82 g) were recorded in $D_1$ date of sowing which were closely followed by $D_2$ (Table 2 and 3). Thereafter, subsequent dates $D_3$, $D_4$, $D_5$ and $D_6$ showed decreasing trend in these growth and yield attributing characters. The reduction in these growth and yield attributing characters was mainly due to the shorter growth period at the disposal of the late sown crop combined with low temperature and less bright sun shine hours (Table 1). The seed yield also showed almost similar trend as the yield attributing characters. The crop sown at $D_1$ and $D_2$ dates took the maximum time period for maturity suggesting that the longer time period taken contributes in maximum plant/height, number of pods/plant, primary branches/plant and test weight, finally resulting increased crop yield.

Looking to the yield attributing characters (Table 3) the grain yield observed in $D_1$ date of sowing were expected better than that of $D_2$ date. But the yield was higher in $D_2$ date of sowing due to more number of surviving plants per hectare in $D_2$ date of sowing. In $D_1$ date of sowing the seedlings could not survive due to the high temperature present in the month of September (Table 1). Seeds per pod were also affected significantly due to different dates of sowing but no definite trend was observed.

### Varieties

Data in Table 2 reveals that varieties showed significant difference in the seed yield. T27 gave significantly higher seed yield over RTM-1 and RTM-2. The average of three years yield data indicated that increase in yield of T27 were 104.89 kg/ha and 54.23 kg/ha over RTM-1 and RTM-2 varieties respectively.

Seeds/pod, height of plant and days to maturity of variety T27 was recorded significantly higher over RTM-1 and RTM-2 (Table 2 and 3). However, seeds per pod did not differ significantly during the year 1980-81 and 1981-82. Evidently these characters attributed to some increase in seed yield of T27 over RTM-1 and RTM-2. Nevertheless, plant stand, test weight and pods/plant did not differ significantly amongst these varieties.

## ACKNOWLEDGEMENT

The authors are thankful to Dr. H. G. Singh, Director of Research and Dr. R. K. Sharma, Professor and Head, Department of Plant Breeding and Genetics, Sukhadia University for providing necessary facilities for successful conduct of the experiment.

## LITERATURE CITED

ANONYMOUS. 1981-82. Annual Report, All India Co-ordinated Research Project on Oil Seed pp. 274-278.

NORDESTGAARD, A. 1978. Trials in winter rape with increasing doses of nitrogen applied in autumn and spring combined with 2 sowing dates, 1971-76. C,f. *Field Crop Abstr.* 31 : 520.

RAI, B. and KUMAR, A. 1981. New technology for mustard production. *Indian Farming* 30 (11) : 7.

SINGH, B. P. and SHARMA, S. C. 1976. In poor soils grow taramira for better return. *Haryana Fmg.* 5 (4) : 5.

TORDORIC. I. 1975. Effect of date of sowing of seed yields of winter rape. C,f. *Field Crop abstr.* 31 : 519.

J. Oilseeds Res. 1(1984) : 11-14

# Studies on the incidence of pests on groundnut in different intercrops

**P. Sivasubramanian and G. A. Palanisamy**
Agricultural Research Station, Tamil Nadu Agricultural University
Aliyarnagar-642 101, India

## ABSTRACT

Incidence of different groundnut pests in various intercrops, was studied during Kharif '81 and Summer '82, at Aliyarnagar. During Kharif '81, significantly less infestation of jassids, thrips and leafminer was observed in the cropping system of groundnut grown with cowpea. In the pure crop of groundnut, maximum incidence of jassids and thrips were recorded (3.12 and 9.8/plant respectively), while blackgram + groundnut cropping system showed maximum incidence of leafminer (11.68/plant).

During 1982 Summer also the treatment differences were significant for jassids, thrips and leafminer. As in the previous season, cowpea + groundnut cropping system registered significantly less incidence of jassids, thrips and leafminer (3.96, 6.52 and 9.20/plant respectively) than other systems.

The study has clearly brought out the benefits of growing cowpea + groundnut cropping system for minimising jassids, thrips and leafminer on groundnut.

**Key words** : *Arachis hypogaea* L. Intercrops; Pulses; Pest incidence

## INTORODUCTION

In groundnut various insect pests cause heavy loss in yield. Among them, thrips, jassids and leafminer are considered as the major limiting factors in the production of groundnut. The losses caused by insect pests are higher in Southern India than in Central or Northern ( Amin, 1983 ). Information on the influence of intercropping on the incidence of the above pests is lacking and with this view a study was conducted during Kharif '81 and Summer '82 at Agricultural Research Station, Aliyarnagar, in Pollachi Taluk of Coimbatore district.

## MATERIALS AND METHODS

The trials were conducted with the groundnut variety POL.2 which is the locally adapted strain. The experiment was laid in randomised block design

Received for publication on October 29, 1983

replicated five times. The plot size adopted was 5m x 5m. The treatments consisted of growing cowpea (Co. 3) after every three rows, blackgram (Co. 3) after every three rows and redgram (Co. 1) after every six rows of groundnut. The Kharif '81 experiment was sown on July 3, 1981 and Summer '82 trial January 7, 1982.

Observations on the incidence of thrips, jassids and leafminer were made by recording the counts of the insects in five randomly selected plants in each replication. The counts were taken from 30th day after sowing at an interval of ten days. Thus a total of five observations were recorded during the crop growth period. Insects were counted on three terminal compound leaves for jassids and thrips. For leafminer, the total number of larvae per plant was recorded. The entire experimental crop was raised in pesticide free zone and final plot yield was recorded. The data on jassids, thrips, and leafminer were subjected to square root transformation and analysed both for individual seasons as well as pooled over seasons.

## RESULTS AND DISCUSSION

The results of both the seasons are presented in Table 1. For Kharif and Summer the treatment differences were significant for the occurrence of all

Table 1 : Mean incidence of pests in individual seasons

| S. No. | Treatment | Jassids | | Thrips | | Leafminer | |
|---|---|---|---|---|---|---|---|
| | | Season I | Season II | Season I | Season II | Season I | Season II |
| | | Kharif | Summer | Kharif | Summer | Kharif | Summer |
| 1. | Groundnut + redgram | 2.22 (1.49) | 5.64 (2.35) | 8.44 (2.90) | 12.68 (3.56) | 11.4 (3.37) | 11.0 (3.31) |
| 2. | Groundnut + blackgram | 2.17 (1.47) | 4.48 (2.11) | 6.84 (2.61) | 6.88 (2.62) | 11.68 (3.41) | 13.48 (3.67) |
| 3. | Groundnut + cowpea | 1.96 (1.39) | 3.96 (1.99) | 5.76 (2.34) | 6.52 (2.54) | 8.40 (2.89) | 9.20 (3.10) |
| 4. | Groundnut | 3.12 (1.74) | 4.08 (2.01) | 9.80 (3.13) | 11.08 (3.33) | 10.52 (3.23) | 11.0 (3.20) |
| | SE± | (0.04) | (0.12) | 0.08 | 0.81 | 0.11 | 0.14 |
| | CD 5% | (0.10) | (0.36) | 0.25 | 0.25 | 0.34 | 0.43 |
| | CV % | 3.26 | 8.01 | 4.01 | 3.65 | 4.64 | 6.06 |

Figures in parentheses are transformed values.

the pests. Jassids and thrips were high in groundnut grown with redgram, whereas leafminer was high in groundnut intercropped with blackgram .Low incidence of all the pests was recorded in groundnut cowpea system.

The results of the pooled analysis over two seasons are presented in Table 2. Significant seasonal differnce for the incidence of thrips and jassids was observed while for leafminer there was no significant difference in the occurrence. In the present study the incidence of jassids and thrips was lower in Kharif *compared to Summer. This is in accordance with Logiswaran (1982)*

Table 2. Pooled analysis of variance over season.

| Source | DF | Mean | | | | Pod yield/ plot (kg.) |
|---|---|---|---|---|---|---|
| | | Incidence of jassids | Thrips | Leaf-miner | Grass-hopper | |
| Seasons | 1 | 3.4192** | 0.7183** | 0.0508 | 7.6125* | 0.2205* |
| Treatments | 3 | 0.1062 | 0.6992** | 0.6118** | 6.9043** | 0.7699** |
| S X T | 3 | 0.1643* | 0.1860** | 0.0567 | 7.8731** | 0.1345 |
| Error | 24 | 0.3715 | 0.0328 | 0.0793 | 0.0866 | 0.1476 |

* Significant at 5% level

** Significant at 1% level

who reported that thrips population is more in dry weather and decreases after rains. Amin (1983) reported that the peak of thrips population (*Frankliniella schultzei*) occurs in August-September and January-February. In the present study, though significant difference was observed for the occurrence of thrips between seasons, the population was high in both the seasons. Amin (1983) also reported that populations of jassids were low from November to March, negligible from April to June and highest in August and September. In the present study the populations of jassids were high in both the seasons. Logiswaran *et al* (1982) observed that a decrease in maximum and minimum temperature will result in increased infestation. In the present study irrespective of low temperature in Kharif and high temperature in Summer, there was no significant difference between seasons. This is in accordance with Rao *et al* (1962) who stated that the pest caused severe damage in both the seasons in Kurnool district of Andhra Pradesh. Nair (1975) also observed that the rainfed groundnuts suffered maximum in July to August and the irrigated groundnuts in February to March in South India.

In the different intercrops studied, there was significant differences for the occurrence of leafminer and thrips. In the intercrop of groundnut+ redgram and groundnut+blackgram, higher incidence of the above two pests was observed in the main crop whereas it was lower in groundnut + cowpea system. This may be due to increased activity of natural enemy in diverse stands. Marcovitch (1935) reported that the low population of strawberry leafroller *Ancylis comptana* fragatiee and the oriental fruit moth, *Gradolita melesta* was observed in peaches intercropped with strawberries compared with sole crops of peach, because the system encouraged their parasitoids.

In the interaction between season and treatment there was significant difference for the incidence of jassids, thrips and grasshopper.

## LITERATURE CITED


AMIN, P. W. 1983. Major field and storage insect pests of groundnut in India and their control. Occassional paper 1/83 ICRISAT, Patancheru, Andhra Pradesh 502 324.

BASS, M.H. and ARANT, F.S. 1973. Insect pests of peanuts. In peanuts-culture and uses. Stone printing company, Roanoke, Virginia, 388-420.

KRISANAMURTHY RAO, S., RANGACHARULU, P. and YESUDAR, T. 1962. Aerial spraying against *surulpoochi (Stomopteryx nertaria)* on summer irrigated groundnut. *The Andhra Agricultural Journal 9* : 202-206.

LOGISWARAN, G., MADAVA RAO, S., VASUDEVAN, G. and V. KANNAN, 1982. Influence of time of sowing and weather factors on the infestation of leafminer *Aproaerema modicella* Deventer and yield in rainfed groundnut. *Madras Agric. J.* 60 : 353-363.

MARCOVITCH, S. (1935) Experimental evidence on the value of strip farming as a method of natural control of injurious insects with special reference to plant lice. *J. Econ. Ent.* 28 : 62-70.

MUMFORD, J and BALIDDAWA, C.W. 1983. factors affecting insect pest occurrence in various cropping systems. *Insect. Sci. Application* 4:59-64.

NAIR, M.R.G.K. 1975. Insects and mites of crops in India. ICAR, New Delhi. 404 pp.

J. Oilseeds Res. 1(1984) : 15-21

# An analysis of association of components of yield in taramira (*Eruca sativa* Linn)

**I. S. Yadav and T. P. Yadava***
Haryana Agricultural University, Regional Research Station, Bawal. India

## ABSTRACT

Taramira (Eruca sativa Linn) is an important oilseed crop which can be grown successfully under drought conditions and marginal lands requiring low inputs. Correlation coefficient and path coefficient analysis were worked out in 30 genotypes of taramira. The variability among the genotypes was large for all the characters studied. Seed yield exhibited significant positive correlation with the siliquae per main shoot, siliquae per plant, seeds per siliqua and primary branches per plant. Path analysis revealed that 1000 seed weight had maximum direct effects on seed yield but its utility is doubtful because its negative indirect effects through other yield attributing traits. Number of primary branches per plant, siliquae per main shoot, seeds per siliqua and siliquae per plant had high degree of direct and indirect effects on seed yield. Therefore, the selection should be imposed on these characters to increase the seed yield in taramira.

**Key words :** Taramira; *Eruca sativa*; Path coefficient; Yield components

## INTRODUCTION

Taramira (*Eruca sativa* Linn.) is an important oilseed crop which requires low inputs and can be grown successfully under soil water deficit condition and in waste and marginal lands. It is comparatively tolerant to insect pests and diseases than other members of rapeseeds and mustard group. It has an efficient root system to extract moisture from lower soil horizons (Singh, 1983) and is more suitable under late sown condition than any other dryland crops. Therefore, to make the best possible use of late winter rains, taramira is the most suitable crop. Information on the association of plant characters with seed yield is of great importance to a breeder in selecting a desirable genotype. Since no information is available on this aspect of the crop, the present investigation was undertaken to find out the association of yield and yield components in taramira using correlation and path coefficient analysis.

---

Received for publication on October 31, 1983

* Present address : Project Director, Directorate of Oilseeds Research, Rajendranagar, Hyderabad-500 030

## MATERIALS AND METHODS

Thirty genotypes of taramira were selected from the collection on the basis of morphological diversity and performance in the small scale trial. The material was raised in a randomised block design with three replications at the Haryana Agricultural University, Regional Research Station, Bawal, during winter of 1982-83. Each genotype was accommodated in 5 m single row spaced 30 cm apart; the distance between plants within rows being 15 cm. Observations on five randomly selected plants from each plot were recorded for days to 50% flowering, plant height (cm), main shoot length (cm), number of primary and secondary branches per plant, number of siliquae per main shoot, siliqua length (cm), number of seeds per siliqua, number of siliquae per plant, 1000 seed weight (g) and seed yield per plant (g). The mean values per plant were statistically analysed. Correlation coefficients were computed following Johnson *et al* (1965) whereas, path coefficient analysis according to Deway and Luy (1959).

## RESULTS AND DISCUSSION

The analysis of variance showed significant differences for the characters studied among the genotypes, indicating adequate variability among them (Table 1). Seed yield exhibited significantly positive correlation with the

Table 1 : Analysis of variance for different traits in taramira

| Source | d.f. | Days to 50% flowering | Plant height | Main shoot length | Number of primary branches | Number of secondary branches |
|---|---|---|---|---|---|---|
| Replication | 2 | 2.82 | 5.12** | 1.66** | 0.07 | 0.08 |
| Treatment | 29 | 15.22** | 74.65** | 20.41** | 4.22** | 10.19** |
| Error | 58 | 0.47 | 0.11 | 0.12 | 0.02 | 0.02 |

Table 1 : (Contd.)

| Siliquae on main shoot | Siliqua length | Seeds per siliqua | Siliquae per plant | 1000 seed weight | Seed yield per plant |
|---|---|---|---|---|---|
| 0.45* | 0.00 | 0.23 | 2.77 | 0.02 | 0.39* |
| 20.08** | 0.01** | 10.76** | 337.73 | 0.24** | 15.75** |
| 0.05 | 0.007 | 0.04 | 0.68 | 0.004 | 0.04 |

* Significant at 5% level

** Significant at 1% level

Table 2. Genotypic and phenotypic correlations in taramira

| | | | Days to 50% flowering | Plant height | Main shoot length | Primary branches per plant | Secondary branches per plant |
|---|---|---|---|---|---|---|---|
| 1. | Days to 50% flowering | G | | 0.422 | 0.357 | —0.302 | –0.118 |
| | | P | | 0.409* | 0.352 | —0.281 | —0.110 |
| 2. | Plant height | G | | | 0.444 | 0.189 | 0.246 |
| | | P | | | 0.441* | 0.189 | 0.245 |
| 3. | Main shoot length | G | | | | 0.284 | 0.175 |
| | | P | | | | 0 285 | 0.177 |
| 4. | Primary branches per plant | G | | | | | 0.758 |
| | | P | | | | | 0.754* |
| 5. | Secondary branches per plant | G | | | | | |
| | | P | | | | | |
| 6. | Siliquae per main shoot | G | | | | | |
| | | P | | | | | |
| 7. | Siliqua length | G | | | | | |
| | | P | | | | | |
| 8. | Seeds per siliqua | G | | | | | |
| | | P | | | | | |
| 9. | Siliquae per plant | G | | | | | |
| | | P | | | | | |
| 10. | 1000 seed weight | G | | | | | |
| | | P | | | | | |

* Significant at 5% level.

Table 2 : (Contd.)

| Siliquae per main shoot | Siliqua length | Seeds per siliqua | Siliquae per plant | 1000 seed weight | Seed yield per plant |
|---|---|---|---|---|---|
| 0.169 | 0.371 | 0.203 | 0.022 | —0.153 | 0.152 |
| 0.162 | 0.348 | 0.201 | 0.027 | —0.122 | 0.149 |
| 0.047 | 0.018 | —0.268 | 0.086 | —0.746 | 0.012 |
| 0.049 | 0.019 | —0.264 | 0.028 | —0.722* | 0.014 |
| 0.334 | —0.124 | 0.395 | 0.328 | —0.247 | 0.344 |
| 0.334 | —0.106 | 0.398 | 0.331 | —0 233 | 0.342 |
| 0.418 | —0.015 | —0.220 | 0.078 | —0.607 | 0.454 |
| 0.419* | —0.003 | —0.210 | 0.082 | —0.589* | 0.452* |
| 0.152 | 0.351 | —0.393 | 0.030 | —0.603 | 0.171 |
| 0.153 | 0.331 | —0.388 | 0.032 | —0.586* | 0.171 |
| | —0.228 | 0.450 | 0.103 | —0.431 | 0.624 |
| | —0.197 | 0.451* | 0.106 | —0.409* | 0.624* |
| | | —0,220 | —0.211 | —0.040 | 0.099 |
| | | —0.179 | —0.181 | 0.023 | —0.067 |
| | | | 0.208 | 0.279 | 0.478 |
| | | | 0.212 | 0.279 | 0.479* |
| | | | | —0.151 | 0.481 |
| | | | | —0.143 | 0.481* |
| | | | | | —0.228 |
| | | | | | —0.207 |

Table 3 : *Direct (diagonal) and indirect effects (off diagonal) on seed yield*

| Character | Days to 50% flowering | Plant height | Main shoot length | Primary branches | Secondary branches |
|---|---|---|---|---|---|
| Days to 50% flowering | 0.246 | 0.845 | —0.484 | —0.411 | —0.052 |
| Plant height | 0.104 | 2.000 | —0.603 | 0.257 | 0.108 |
| Main shoot length | 0.088 | 0.888 | —1.356 | 0.386 | 0.077 |
| Primary branches/plant | 0.074 | 0.378 | —0.385 | 1.360 | 0.333 |
| Secondary branches/plant | 0.029 | 0.492 | —0.238 | 1.030 | 0.439 |
| Siliquae on main shoot | 0.041 | 0.094 | —0.453 | 0.569 | 0.067 |
| Siliqua length | 0.091 | 0.035 | 0.168 | —0.020 | 0.154 |
| Seeds/siliqua | 0.050 | —0.536 | —0.536 | —0.299 | —0.173 |
| Siliquae/plant | 0.006 | 0.173 | —0.444 | 0.106 | 0.013 |
| 1000 seed weight | 0.030 | —1.491 | 0.335 | —0.825 | —0.265 |

Residual effect ± 0.041.

Table 3 : (Contd.)

| Siliquae on main shoot | Siliqua length | Seeds per siliqua | Siliquae per plant | 1000 seed weight | Correlation with yield |
|---|---|---|---|---|---|
| 0.156 | 0.039 | 0.155 | 0.017 | —0.359 | 0.152 |
| 0.043 | 0.002 | —0.205 | 0.065 | —1.759 | 0.012 |
| 0.308 | —0.013 | 0.302 | 0.246 | —0.582 | 0.344 |
| 0.386 | —0.002 | —0.168 | 0.058 | —1.432 | 0.454 |
| 0.141 | 0.036 | —0.301 | 0.023 | —1.422 | 0.171 |
| 0.924 | —0.024 | 0.344 | 0.078 | —1.016 | 0.624 |
| —0.210 | 0.105 | —0.169 | —0.158 | —0.095 | —0.099 |
| 0.416 | —0.023 | 0.765 | 0.156 | 0.658 | 0.478 |
| 0.095 | —0.022 | 0.159 | 0.751 | —0.356 | 0.481 |
| —0.398 | —0.004 | 0.213 | —0.113 | 2.358 | —0.228 |

number of siliquae on main shoot, number of siliquae per plant, seeds per siliquae and primary branches per plant (Table 2). Days to 50% flowering had a positive correlation with plant height while plant height showed positive correlation with main shoot length and negative correlation with 1000 seed weight. Primary branches per plant were positively associated with secondary branches per plant and number of siliquae on main shoot. Relationship between number of siliquae on main shoot and number of seeds per siliquae was positive. Therefore, selection should be imposed on number of siliquae per main shoot, number of siliquae per plant, number of seeds per siliqua and number of primary branches per plant for increasing the seed yield in taramira.

Studies on the direct and indirect effects (Table 3) revealed that the direct effects of number of siliquae per plant, number of primary branches per plant, number of seeds per siliqua and number of siliquae on main shoot, on seed yield were high and positive. Indirect effects of number of siliquae per plant via number of seeds per siliqua and number of primary branches per plant were also high and positive, whereas its indirect effects via number of siliquae on main shoot were negligible. This showed that number of siliquae per plant influenced seed yield directly as well as indirectly via number of seeds per siliqua and number of primary branches per plant but not via siliquae on main shoot indicating thereby that more the number of siliquae per plant and higher the number of seeds per siliquae and primary branches per plant, more would be the seed yield per plant. Path analysis showed that 1000 seed weight had a direct positive effect on seed yield when the effects of other components were kept constant. Therefore, its utility is doubtful besause of its negative indirect effects through other yield attributing traits. Similar trend was observed in pea by Narsinghani *et al* (1978). Besides high direct effects, primary branches reduced the effects on seed yield indirectly via main shoot length, seeds per siliqua and 1000 seed weight. Though direct contribution of seeds per siliqua was highly positive, its indirect effects through other characters diluted the effects on seed yield. Apart from the high direct effects of siliquae per main shoot and siliquae per plant on seed yield, most of other characters had positive indirect effects via these characters.

The fundamental reason for the invariably important role of siliquae per plant in determining the seed yield might be that each siliqua was a direct unit of yield and any variation in number of siliquae would be correlated with the seed yield. From the study it may be concluded that the number of siliquae per plant, seeds per siliqua and siliquae per main shoot had direct and indirect positive and significant association with seed yield. Therefore, selection should be imposed on these characters to get better results in increasing the seed yield of taramira.

## LITERATURE CITED

DEWEAY, D .R. and LU, K. H. 1959. A correlation and path-coefficient analysis of components of crestred grass seed production. *Agron. J.* 51 : 515-518.

JOHNSON, H.W., ROBINSON, H. F. and COMSTOCK, R. E. 1965. Genotypic and phenotypic correlations in soybeans and their implications in selection. *Agron. J.* 47 : 477-483.

NARSINGHANI, V. C., KANWAL, C. S. AND SINGH, S. P. 1978. Path analysis of yield components in pea. *Indian J. Agric. Sci.* 48 : 848-850.

SINGH, B.P. 1983. Response of taramira to sulphur application. *Indian J. Agric. Sci.* 53 : 676-680.

J. Oilseeds Res. 1(1984) : 23-28

# Control of late leaf spot and rust of groundnut by combination spray of carbendazim and tridemorph

**M. B. Patil, K. A. Attarde and A. B. Deokar**
Oilseeds Research Station,
Mahatma Phule Agricultural University, Jalgaon 425 001.
Maharashtra, India

## ABSTRACT

Spraying of Carbendazim (Bavistin 50 WP) at the rate of 0.05% and tridemorph (Calixin 80 EC) at the rate of 0.07% inhibited the development of Cercospora leaf spot and rust respectively. A combination spray of carbendazim and tridemorph was found to reduce the intensity of both late leaf spot and rust significantly and gave significant increase in yield.

**Key words :** Groundnut; late leaf spot; rust; chemical control

## INTRODUCTION

Rust caused by *Puccinia arachidis* Speg. and late leaf spot caused by *Cercosporidium personatum* (Berk and Curt) Deighton are two destructive foliar diseases of groundnut in India (Mayee *et al.* 1977 and Subrahmanyam *et al.* 1979). Combined losses due to leaf spot and rust have been reported to the tune of 70 per cent (Ghuge *et al.* 1981 and Subrahmanyam *et al.* 1980). Carbendazim and tridemorph are known to be effective against foliar diseases (Ghuge *et al.* 1980 and Patil *et al.* 1979, 1983). It was therefore, planned to test their efficacy for three years in different varieties.

## MATERIALS AND METHODS

The experiment was conducted on four improved varieties during Kharif, 1980, 1981 and 1982 in factorial randomised block design with five replications. Improved varieties viz. S.B. XI ($V_1$), JL-24 ($V_2$), TMV-10 ($V_3$) and M-13 ($V_4$) were used as main treatments and fungicides viz. carbendazim ($T_1$), tridemorph ($T_2$), carbendazim+tridemorph ($T_3$) and control ($T_4$) were the sub-treatments. Concentrations of carbendazim [(2-Methoxy Carbamoyl)-benzimidazole] and tridemorph (N-tridecyl - 2,6-dimethyl morpholine) used were 0.05% and 0.07%

---

Received for publication on November 3, 1983

Table 1 : Per cent disease intensity of late leaf spot and rust (in Arcsin values) and its effect on pod yield.

| Treatment | Late leaf spot per cent intensity | | | | Rust intensity | |
|---|---|---|---|---|---|---|
| | 1980-81 | 1981-82 | 1982-83 | Average | 1980-81 | 1981-82 |
| $V_1T_1$ | 18.93 | 8.76 | 16.17 | 14.62 | 26.46 | 29.07 |
| $V_1T_2$ | 25.12 | 27.23 | 26.12 | 26.16 | 19.56 | 14.32 |
| $V_1T_3$ | 18.09 | 10.83 | 16.55 | 15.16 | 17.47 | 17.48 |
| $V_1T_4$ | 32.54 | 35.78 | 31.79 | 33.37 | 34.49 | 30.12 |
| $V_2T_1$ | 16.65 | 7.15 | 15.50 | 13.10 | 21.60 | 20.78 |
| $V_2T_2$ | 22.95 | 29.34 | 20.88 | 24.39 | 16.93 | 10.48 |
| $V_2T_3$ | 16.79 | 8.53 | 13.69 | 13.00 | 16.60 | 10.47 |
| $V_2T_4$ | 31.46 | 34.46 | 27.84 | 31.26 | 30.38 | 29.96 |
| $V_3T_1$ | 23.08 | 9.68 | 15.06 | 15.94 | 20.62 | 21.93 |
| $V_3T_2$ | 21.09 | 19.46 | 22.16 | 20.90 | 21.29 | 9.94 |
| $V_3T_3$ | 21.58 | 10.46 | 15.31 | 15.78 | 20.24 | 11.64 |
| $V_3T_4$ | 28.23 | 23.38 | 29.30 | 26.97 | 28.12 | 25.79 |
| $V_4T_1$ | 22.07 | 10.80 | 15.07 | 15.98 | 20.28 | 30.29 |
| $V_4T_2$ | 20.50 | 25.30 | 24.15 | 23.31 | 19.23 | 10.62 |
| $V_4T_3$ | 21.77 | 13.79 | 15.20 | 16.92 | 21.10 | 13.52 |
| $V_4T_4$ | 24.94 | 33.06 | 29.70 | 29.23 | 22.94 | 31.41 |
| S.E. ± | 0.54 | 1.179 | 1.141 | 1.245 | 0.58 | 0.69 |
| C.D. 5% | 5.56 | 3.569 | N.S. | 4.935 | 1.68 | 1.96 |
| S.E. for table | 0.95 | 2.358 | 0.571 | 3.489 | 1.02 | 1.96 |
| C.D. for table | 2.75 | N.S. | 1.614 | N.S. | 2.96 | 3.85 |

Table 1 : (Contd.)

| Rust intensity | | Dry pod yield in kg/ha | | | | % Loss |
|---|---|---|---|---|---|---|
| 1982-83 | Average | 1980-81 | 1981 82 | 1982-83 | Weighted mean | |
| 23.74 | 26 42 | 913 | 1634 | 847 | 952 | 23.6 |
| 13.94 | 15.94 | 913 | 1533 | 729 | 837 | 13.2 |
| 14.92 | 16.62 | 958 | 1581 | 933 | 1020 | 38.7 |
| 26.64 | 30.41 | 828 | 1383 | 625 | 727 | — |
| 14.84 | 19.07 | 1190 | 2520 | 1696 | 1806 | 16.8 |
| 13.57 | 13 66 | 1171 | 2381 | 1736 | 1823 | 17.7 |
| 13.99 | 13.68 | 1349 | 2599 | 1849 | 1949 | 23.0 |
| 21.67 | 27.00 | 933 | 2222 | 1382 | 1500 | — |
| 23.23 | 21 93 | 362 | 1351 | 107 | 274 | 23.72 |
| 12.93 | 14.72 | 362 | 1254 | 60 | 220 | 5.00 |
| 14.24 | 15.37 | 466 | 1548 | 95 | 290 | 27.89 |
| 25.49 | 26.47 | 327 | 1151 | 63 | 309 | — |
| 21.77 | 24 11 | 1056 | 1565 | 685 | 803 | 41.81 |
| 12.26 | 14.04 | 997 | 1401 | 615 | 720 | 35.27 |
| 13.88 | 16.17 | 937 | 1734 | 605 | 756 | 18.35 |
| 27.23 | 27.19 | 928 | 1434 | 316 | 466 | — |
| 0.68 | 1.51 | 99.2 | 32.9 | 29.8 | 39.7 | |
| 2.07 | 4.37 | 285.9 | 93.1 | 48.1 | 137.4 | |
| 0.44 | 3.03 | 99.2 | 65.9 | 04.0 | 95.1 | |
| 1.25 | N.S. | N.S. | N.S. | 39.5 | N.S. | |

respectively. First spray was commenced 30 days after sowing and the remaining three sprays at an interval of 20 days. Artificial epiphytotic conditions were created by spraying conidial suspension of late leaf spot and uredospores of rust. High humidity was created by spraying water frequently. Disease intensities were recorded 90 days after sowing in JL-24 and 100 days after sowing in remaining three varieties. The observations were recorded on ten randomly selected plants and the intensity of late leaf spot was graded by recording the per cent affected leaf area.

## RESULTS AND DISCUSSION

**Effect on disease intensity :**

Results of the pooled analysis indicated that the plots sprayed with carbendazim alone significantly reduced the intensity of leaf spot, while tridemorph alone reduced the intensity of rust significantly. A mixture of carbendazim and tridemorph reduced the intensity of both late leaf spot and rust efficiently

Table 2 : Cost benefit ratio for the fungicides (carbendazim and tridemorph)

| Sr. No | Fungicides | Cost of 1000 g in Rs. | Quantity required in g/ha | Cost of fungicides/ ha in Rs. including cost of application | Addl. yield of dry pods (kg) | Cost of Addl. return/ ha @ Rs. 500/q | Net profit/ loss per ha in Rs. | Cost benefit ratio |
|---|---|---|---|---|---|---|---|---|
| 1. | Carbendazim | 385 | 1000 | 445 | 194.00 | 970.00 | 425.00 | 1:2.17 |
| 2. | Tridemorph | 310 | 1400 | 494 | 130.00 | 650 00 | 156.00 | 1:2.31 |
| 3. | Carbendazim + | 385 | 1000 | 879 | 255.00 | 1275.00 | 396.00 | 1:1.45 |
| | Tridemorph | 310 | 1400 | | | | | |

Cost of application of fungicides Rs. 15.00/ha per spray

(Table 1). This clearly indicated that tridemorph is selective in inhibiting only rust, while carbendazim is effective in reducing late leaf spot infection.

Similar results were obtained by Mayee *et al.* (1978, 1979) and Ghuge *et al* 1980). No varietal differences in infection or inhibition of late leaf spot and rust were observed,

**Effect on yield of groundnut** :

Reduction in both the diseases resulted in significant increases in pod yield. Loss in yield due to leaf spot in most susceptible variety S.B.XI was 13.2 per cent and combined losses were observed to be 28.7 per cent (Table 2). Cost benefit ratio for these fungicides were also worked out and these fungicides viz. carbendazim, tridemorph and their combinations were found economical giving cost benefit ratio of 1:2.17, 1:1.31 and 1:1.45 respectively (Table 2).

**ACKNOWLEDGEMENT**

The authors are thankful to the Indian Council of Agricultural Research, New Delhi for making funds available for these investigations.

**LITERATURE CITED**

GHUGE, S. S., MAYEE, C. D. and GODBOLE, G. M. 1980. Development of rust and leaf spots of groundnut as influenced by foliar application of carbendazim and tridemorph. Pesticides 14 (6) : 16-19.

MAYEE, C.D., PATIL, F. S. and RAUT, K. G. 1978. *Effectiveness of tridemorph* in reducing intensity of rust of groundnut. Pestology 2 : 25-26.

MAYEE, C.D., PATIL, M.A., GODBOLE, G.M., KIDE, D.S. and PATIL, F.S. 1979. Fungicidal control of groundnut rust. Pesticides 13(10) : 13-14.

PATIL, M. B., WANI, P. V. and PATIL, G. D. 1979. Evaluation of fungicides for the control of groundnut leaf rust (*Puccinia arachidis* Speg.) Pesticides. 23 (3) : 24-25.

PATIL, M. B., WANI, P. V. and JADHAV, B. R. 1983. Efficacy and chemical management of groundnut rust. J. Maharashtra Agricultural University 8(2) : 178-179.

SUBRAHMANYAM, P., REDDY, D. V. R., GIBBONS, R. W., RAO, V. R. and GARRENIK. H. 1979. Current distribution of grouno rust in India. PANS. 25(1): 25-29.

SUBRAHMANYAM, P., MEHAN, V. K., NEVILL, D. J., Mc DONALD, D. 1980. Research on fungal diseases of groundnut in ICRISAT *Proc. Int. Workshop on Groundnut*, 13-17 Oct., 1980, ICRISAT Patancheru pp. 193-198.

J. Oilseeds Res. 1(1984) : 29-36

# Intercropping sunflower with groundnut under rainfed conditions

**S. M. Nikam, V. G. Patil, and A. B. Deoker**
Agricultural Research Station, Jalgaon 425 001.
Maharashtra, India

## ABSTRACT

Studies on intercropping sunflower (Helianthus annuus L.) with groundnut (Arachis hypogaea L.) under rainfed conditions was conducted during 1979 to 1981 at the Agricultural Research Station, Jalgaon. Intercropping increased the total oilseeds production as well as total oil production. However, highest monetary return was obtained from sole crop of groundnut which was at par with two skip rows + 5 rows of groundnut, (1:5), one skip row + 3 rows of groundnut (1:3) and paired row + 2 rows of groundnut (1: 2). The planting patterns of sunflower affected the yields of sunflower considerably. The mean LER was maximum in one skip row + 3 rows of groundnut (1. 17). LER values decreased due to planting patterns whereas it was maximum due to intercrop of groundnut (1. 14) than sole crop of sunflower (0.76).

**Key Works :** Intercropping; Groundnut; Sunflower

## INTRODUCTION

Sunflower *(Helianthus annuus L.)* is a photo-insensitive crop well adapted to a wide range of environments (Daulay *et al*, 1974). Shukla (1972) also stated that the importance of the crop is being realised because of its adaptability to various climate and types of soil, high yield potential and quality oil per unit area and time.

As it is a widely spaced crop, intercropping of commonly grown annual rainy season grain legumes appear to be a distinct possibility. Till recently, intercropping systems for drylands were designed more for reduction of risk of total crop failure than for stabilizing yield in years of low rainfal and maximising total productivity per unit area, time and water in years of normal or good rainfall.

With the availability of new high yielding, short duration varieties of cereals, pulses and oilseeds with different types of canopy architecture, it is now, *possible to design suitable intercropping systems with sunflower as the principal* crop grown on drylands. Keeping this in view, groundnut *(Arachis hypogaea L.)* was tried as an intercrop in rainfed sunflower grown in different planting patterns without reducing its plant population,

Received for publication on November 4, 1983

## MATERIALS AND METHODS

The experiment was carried out at the Agricultural Research Station, Jalgaon during the Kharif seasons of 1979, 1980 and 1981. The soil of the experimental plot was clayey in texture, with 8. 2 pH, medium in available nitrogen (0. 05 to 0. 6%) and phosphorus (30 to 55 kg/ha) during all the years of experimentation. Experiment was conducted in a randomized block design with three replications. Nine treatment combinations viz. $T_1$ = sole crop of groundnut (30 × 10 cm); $T_2$ = sole crop of sunflower (60 × 30 cm); $T_3 = T_2$ + one alternate row of groundnut; $T_4$ = paired planting of sunflower (30 – 90 × 30 cm); $T_5 = T_4$ + two rows of groundnut; $T_6$ = alternate skip row of sunflower (120 × 15 cm); $T_7 = T_6$ + three rows of groundnut; $T_8$ = two skip rows of sunflower (180 × 10 cm) and $T_9 = T_8$ + five rows of groundnut.

Recommended doses of fertilizers were applied to sunflower (50 kg N + 30 kg $P_2O_5$ + 20 kg $K_2O$/ha) and groundnut (20 kg N + 40 kg $P_2O_5$ ha) crops on plant population basis. The entire dose of N and P was applied to groundnut at sowing while half dose of N and full dose of P and K was applied to sunflower crop at sowing and the remaining half dose of N was applied 30 days after sowing in all the years.

Sunflower variety EC 101495 and Phule Pragati (JL 24) a high yielding and early maturing bunch variety of groundnut was used in the experiment. Both, main crop of sunflower and intercrop of groundnut, were sown simultaneously in the first week of July during all the years. The yield was evaluated on the basis of net plot size of 4.8 × 4.2 m.

In general, the rainfall was quite good for the crop growth in all the years. The wether parameters are given in Table 1.

## RESULTS AND DISCUSSION

Data of seed yields of sunflower, dry pod and hauim yields of groundnut, total land equivalent ratio (LER) for main produce and monetary returns as influenced by different treatments are presented in Table 2 and 3.

The planting patterns of sunflower affected the yields of sunflower considerably in all the years. The average yield of 3 years (Table 2) showed that inclusion of groundnut as an intercrop increased the total oilseeds production as well as total oil production and all combinations gave higher yield of total oilseeds and total oil production than sunflower and groundnut grown as sole crops.

The yields of groundnut were more in skip row system of planting of sunflower. The wider spacing of sunflower provided ample space for the growth of groundnut.

Table 1. Climatic parameters during the crop period

| Month | Rainfall (mm) | | | Rainy days | | | Temperature (°C) | | | | | | Humidity (%) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1979 | 1980 | 1981 | 1979 | 1980 | 1981 | 1979 | | 1980 | | 1981 | | 1979 | 1980 | 1981 |
| | | | | | | | Max | Min | Max | Min | Max | Min | | | |
| June | 136.1 | 196.2 | 62.2 | 10 | 16 | 6 | 40.6 | 27.5 | 35.6 | 24.9 | 39.5 | 27.1 | 66 | 85 | 68 |
| July | 260.3 | 89.6 | 231.2 | 19 | 14 | 24 | 33.0 | 24.3 | 32.8 | 24.5 | 31 3 | 24.2 | 85 | 84 | 86 |
| Aug. | 221.2 | 252.0 | 364.4 | 16 | 21 | 21 | 30.2 | 22.8 | 30.3 | 23.6 | 30.0 | 23.3 | 88 | 91 | 90 |
| Sept. | 132.8 | 69.4 | 75.0 | 10 | 4 | 12 | 33.4 | 23.0 | 33.7 | 23.5 | 32.3 | 23.9 | 85 | 83 | 86 |
| Oct. | 45.2 | — | 24.0 | 3 | — | 6 | 35.1 | 22.6 | 37.1 | 20.4 | 31.0 | 20.1 | 78 | 66 | 68 |
| Total | 795.6 | 607.2 | 756.8 | 58 | 55 | 69 | | | | | | | | | |

Table 2. Mean seed yield of sunflower, dry pods and haulm yields (kg/ha) of groundnut, total LER for main produce and total monetary returns (Rs/ha) as influenced by different treatments

| Treatments | 1979 | | | 1980 | | | 1981 | | |
|---|---|---|---|---|---|---|---|---|---|
| | Sunflower | Groundnut | | Sunflower | Groundnut | | Sunflower | Groundnut | |
| | Seed yield (kg/ha) | Dry pods (kg/ha) | Haulm (kg/ha) | Seed yield (kg/ha) | Dry pods (kg/ha) | Haulm (kg/ha) | Seed yield (kg/ha) | Dry pods (kg/ha) | Haulm (kg/ha) |
| 1. G | — | 1428 | 5208 | — | 1172 | 4216 | — | 1777 | 4629 |
| 2. S | 1250 | — | — | 1179 | — | — | 1134 | — | — |
| 3. S+G (1:1) | 1056 | 576 | 2316 | 1042 | 222 | 992 | 977 | 422 | 2149 |
| 4. SP | 1002 | — | — | 1173 | — | — | 878 | — | — |
| 5. SP+G (1:2) | 1066 | 606 | 3139 | 1024 | 322 | 1904 | 749 | 564 | 2480 |
| 6. $SSK_1$ | 794 | — | — | 487 | — | — | 725 | — | — |
| 7. $SSK_1$ (1:3) | 784 | 920 | 3472 | 762 | 643 | 2149 | 553 | 966 | 3968 |
| 8. $SSK_2$ | 610 | — | — | 675 | — | — | 871 | — | — |
| 9. $SSK_3$+G (1:5) | 461 | 1071 | 4648 | 240 | 861 | 3059 | 711 | 1166 | 3720 |
| S. E. ± | 84.07 | — | — | 97.96 | — | — | 46.89 | — | — |
| C. D. 5% | 255.05 | — | — | 297.17 | — | — | 140.12 | — | — |

G = Sole crop of groundnut; S = Sole crop of sunflower; SP = paired planting of sunflower; $SSK_1$ = Sunflower one skip row; $SSK_2$ = Sunflower two skip rows

Table 2 : (Contd.)

| Mean oilseeds production (kg/ha) | Mean oil production (kg/ha) | LER | | | Mean | Total monetary returns | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | 1979 | 1980 | 1981 | | 1979 | 1980 | 1981 | Average |
| 1459 | 510.65 | 1.00 | 1.00 | 1.00 | 1.00 | 4345 | 5208 | 8929 | 6158 |
| 1188 | 475.20 | 1.00 | 1.00 | 1.00 | 1.00 | 2942 | 3542 | 3973 | 3483 |
| 1432 | 552.33 | 1.24 | 1.07 | 1.10 | 1.14 | 4276 | 4142 | 5759 | 4724 |
| 1018 | 407.06 | 0.80 | 0.99 | 0.77 | 0.85 | 2361 | 3522 | 3075 | 2984 |
| 1444 | 522.97 | 1.27 | 1.14 | 0.98 | 1.13 | 4629 | 4633 | 5665 | 4975 |
| 669 | 267.46 | 0.63 | 0.41 | 0.65 | 0.56 | 1870 | 1463 | 2546 | 1957 |
| 1543 | 574.91 | 1.28 | 1.20 | 1.03 | 1.17 | 4692 | 5124 | 7019 | 5610 |
| 719 | 287.46 | 0.49 | 0.57 | 0.77 | 0.61 | 1438 | 2029 | 3051 | 2172 |
| 1503 | 549.69 | 1.12 | 0.93 | 0.29 | 1.11 | 4876 | 4544 | 8482 | 5966 |
| — | — | — | — | — | — | 263.78 | 299.05 | 410.61 | 449.10 |
| — | — | — | — | — | — | 790.82 | 896.47 | 1230.89 | 1278.71 |

| | Market rates Rs/q | | |
|---|---|---|---|
| | 1979 | 1980 | 1981 |
| Sunflower grains | 235 | 300 | 350 |
| Groundnut dry pods | 250 | 390 | 450 |
| Groundnut haulm | 15 | 15 | 20 |

**Table 3 :** Mean seed yield of sunflower, dry pods and haulm yields of groundnut, mean LER for main produce and mean monetary returns as influenced by planting patterns and intercrops

| Treatments | Seed yield of sunflower (kg/ha) | Yield of groundnut (kg/ha) | | Mean oilseeds production (kg/ha) | Mean LER for total main produce | Mean monetary returns (Rs/ha) |
|---|---|---|---|---|---|---|
| | | Dry pods | Haulm | | | |
| Planting patterns | | | | | | |
| 1. Solid planting | 1106 | 407 | 1819 | 1513 | 1.07 | 4103 |
| 2. Paired row | 982 | 497 | 2508 | 1479 | 0.98 | 3980 |
| 3. One skip row | 684 | 843 | 3196 | 1525 | 0.86 | 3784 |
| 4. Two skip rows | 595 | 1032 | 3809 | 1627 | 0.88 | 4069 |
| Intercrops | | | | | | |
| 1. No intercrop | 1198 | — | — | 1198 | 0.76 | 2650 |
| 2. Intercrop of groundnut | 785 | 695 | 2833 | 1480 | 1.14 | 5319 |
| General Mean | 891 | 579 | 2833 | 1471 | 0.95 | 3984 |

A combination of one skip row of sunflower + 3 rows of groundnut and two skip rows of sunflower + 5 rows of groundnut gave higher yield of total oilseeds than groundnut as a sole crop. The highest total production was found with one skip row + 3 rows of groundnut (1:3) followed by two skip rows + 5 rows of groundnut (1:5) probably because of less shading effect on the groundnut crop due to more space left in between two rows of sunflower. Similar trend was also observed in case of total oil production. Paired and skip row planting of sunflower in general, reduced the yield of sunflower. However, inclusion of groundnut as an intercrop increased the total oilseed production in all the planting patterns. Singh and Singh (1977) also reported that the total productivity of the intercropping systems was 74 per cent higher than the sole cropping of sunflower. Desai and Goyal (1980) also observed similar trends in intercropping as regards to production.

Intercropping of groundnut and sunflower in 6 : 2 proportions gave the highest seed yield (1371 kg/ha) at Akola (Anonymous, 1978) whereas sole crop of sunflower EC 68414 yielded highest (1270 kg/ha) followed by groundnut + sunflower in 5: 2 ratio (941 kg / ha) at Coimbatore (Anonymous, 1982).

In the present studies, mean LER was maximum in one skip row planting + three rows of groundnut (1.17) which showed 20 per cent biological advantage followed by paired system + two rows of groundnut. The mean LER was maximum with intercrop (1. 14) than no intercrop (0. 76).

The monetary returns showed significant differences in all the years. The paired and skip row system of planting reduced the monetary returns (Table 3). The adverse effect of planting patterns, namely paired and skip, may be attributed to the wider space requirement of the crop all around the plant.

On pooling the results for three years treatment differences were found to be highly significant for total monetary returns. Significantly higher returns were obtained from sole crop of groundnut which was at a par with two skip rows + 5 rows of groundnut (1:5), one skip row + 3 rows of groundnut (1: 3) and paired row + 2 rows of groundnut (1:2). The reason for higher return obtained from groundnut alone, may be due to the high market rates of groundnut than sunflower and also the use of high yielding and early maturing variety of groundnut. The monetary returns revealed that the money values increased substantially due to intercropping of groundnut with sunflower than sole crop of sunflower. The monetary return was double due to intercrop of groundnut than sole crop of sunflower (Table 3). Similar findings are also reported by Desai and Goyal (1980) and Singh and Singh (1977). At Coimbatore, (Anonymous 1982) sole crop of sunflower gave the highest net returns (Rs 2015.00/ha) followed by groundnut + sunflower in 5 : 2 ratio (Rs 941.00/ha) whereas at Bangalore

(Anonymous 1978), among the combinations, sunflower × groundnut gave higher returns than sunflower × ragi and sunflower × soybean, while at Akola (Anonymous 1978) intercropping of groundnut and sunflower in 6 : 2 proportion gave the highest return (Rs. 3720.00/ha). The error variance was observed to be homogenous when data for monetary returns over three years were pooled. Interaction due to various treatments and seasons was highly significant.

## LITERATURE CITED

ANONYMOUS. 1978. Annual Progress Report, *Twelfth Annual Workshop (Kharif crops)* April, 24-27, 1978. Vol. II.

ANONYMOUS. 1982. Annual Progress Report. *Annual Kharif Oilseeds Work-shop.* May, 7-11, 1982.

DAULAY, H. S., SINGH, R. P. and SINGH, K. C. 1974. Sunflower—a potential crop for drylands of Rajasthan. *Indian Fmg.* 23 (10) : 21-22.

DESAI, N. D. and GOYAL, S. N. 1980. Intercropping of sesame with other oil-seeds crops. *Indian J. Agric. Sci.* 50 (8) : 603-605.

SHUKLA, H. 1972. Will sunflower win the oil race? *Intensive Agric.* 10 (3) : 25.

SINGH, K. C. and SINGH, R. P. 1977. Intercropping of annual grain legumes with sunflower. *Indian J. Agric. Sci.* 47 (11) : 533-537.

J. Oilseeds Res. 1(1984) : 37-48

# Physiological aspects of yield improvement in *Brassica* species with reference to plant density

# I. Dry matter accumulation and growth attributes

**S. E. Shaik Khader and S. C. Bhargava**
Division of Plant Physiology
Indian Agricultural Research Institute, New Delhi - 110 012. India

## ABSTRACT

Dry matter production and growth of Cv. Pusa Bold (Brassica juncea) and Cv. Pusa Kalyani (B. campestris) were measured in relation to plant spacing under irrigated and unirrigated conditions during the Rabi (winter) seasons of 1980 and 1981. In both species dry matter production in leaves, stem and pods increased significantly with increasing plant density and irrigation. Between 85 to 90% of the total dry matter accumulated after flowering. Leaf area index (LAI) ranged between 3 to 6, depending on the treatment, at 65 days after sowing. Net assimilation rate (NAR) was lower while crop growth rate (CGR) was higher at high density. Crop growth rate increased as LAI increased and did not decrease until maximum LAI was obtained, indicating the absence of optimum LAI. Maximum CGR values were 19.3 and 28.4 g/day/m$^2$ under unirrigated and irrigated conditions respectively. Plant density significantly affected CGR. The respective maximum CGR values were 27.4 and 30.4 g/day/m$^2$ under high population and 18.8 and 21.6 g/day/m$^2$ under low population density during two seasons.

**Key words :** Rapeseed-mustard physiology; plant population; growth analysis; dry matter production

## INTRODUCTION

In India, the cruciferous oilseed crop rapeseed-mustard occupies an area of 3.6 milion hectares with an average yield of 600 kg/ha. This low productivity may be attributed to the fact that in India rapeseed-mustard is grown over 90% of the area under rainfed conditions in marginal lands of low fertility with poor input and cultural management. Besides, the species grown have relatively more profuse vegetative growth and branching pattern (Bhargava and Tomar 1982). This growth pattern limits the number of plants/m$^2$ to about 12-15 compared to 100-300 plants/m$^2$ used in countries like Canada and Britain. (Clarke and Simpson 1978; Scarisbrick *et al*, 1982).

Received for publication on November 4, 1983

Optimizing plant density is an important strategy for improving productivity in crop plants. In recent years it has been recognised and emphasised that increasing plant density and response to inputs such as irrigation should be considered important objectives for improving yields in *Brassica* species. To understand the physiological basis of yield, growth parameters have been studied in *Brassica* species by Allen and Morgan (1972, 1975), Thurling (1974), Clarke and Simpson (1978) and Chauhan (1980). The present study examines the growth and dry matter accumulation by two *Brassica* species in relation to plant density.

## MATERIALS AND METHODS

The experiment was carried out during the 1980-81 and 1981-82 Rabi (winter) cropping season at Indian Agricultural Research Institute, New Delhi using *Brassica campestris* (Cv. Pusa Kalyani) and *Brassica juncea* (Cv. Pusa Bold). The dates of sowing were 16 October and 22 October for the two respective years. The experimental design was a split plot with three replications, with irrigation as main plot treatment and varieties and spacings as sub-plot treatments. For the irrigated conditions, two irrigations, one at flowering and the other at pod filling were given. The plot size was 5 × 5 m. There were three levels of spacing; plant to plant distance in the row was kept constant at 15 cm with three row spacings viz. 15, 30 and 45 cm which gave plant populations of 44, 22 and 15 plants/$m^2$ respectively. The desired population was maintained precisely by thinning 15 days after sowing. All the plots received a basal fertilizer dose of 40 kg N, 40 kg $P_2O_5$ and 40 kg $K_2O$ per hectare prior to sowing. Weeding was done thrice during the crop growth period.

Sampling at 15 days interval was started 35 days after sowing. Three representative plants per replicate were pulled out and divided into leaves, stem and pods and dried for 24 hours at 80°C in oven. For leaf area measurements a few leaves were taken from the plants randomly from different positions and their area was recorded in an electronic leaf area meter and these were finally weighed after drying. The remaining leaves were oven dried and their area computed on the basis of area to weight ratio of the sample at each growth stage for each replicate. Dry weights of plant parts were expressed for unit ground area.

The growth parameters like net assimilation rate (NAR), crop growth rate (CGR) and relative growth rate (RGR) were calculated using the formulae given by Radford (1967).

## RESULTS

The relative population density and irrigation effects on growth attributes and dry matter production were similar in both the trials and hence only the results of the first trial are described in detail.

**Dry matter production**

Leaf dry weight at various growth stages increased steadily upto 65 days and declined thereafter (Table 1). Irrigation significantly enhanced dry matter accumulation during the exponential growth stage. The decline in leaf dry weight after 65 days was primarily due to senescence of matured leaves. Significant increase in leaf dry matter was noticed with increasing levels of population density. It also appears that more of dry matter is produced by increasing plant density.

The stem dry weight increased steadily with marginal fluctuation upto 95 days after sowing (Table 1). The dry weight at various stages of growth was significantly higher when irrigation was given. As in the case of leaves, stem dry weight increased with increasing population density.

Irrespective of treatment, dry matter accumulation in pods increased continuously with time (Table 1). Irrigation did not appear to influence the pod weight significantly in the early stages of development. The effect was however more pronounced at later stages. Of the two cultivars studied Pusa Bold exhibited significantly more dry matter accumulation at all stages than Pusa Kalyani. The dry weight of leaves, stems and pods increased with increasing population density.

Total dry matter increased with age (Table 1). Irrigation gave significantly higher dry matter accumulation than unirrigated conditions at all stages of growth. The variety Pusa Bold accumulated more dry matter than Pusa Kalyani. Total dry matter increased with decreasing spacing; the narrowest spacing of $15 \times 15$ cm giving the greatest accumulation at various growth stages. Obviously in the present study the total dry matter in rapeseed-mustard increased with increasing population density at least upto 44 plants/$m^2$.

The per cent of the total dry matter accumulating during the post flowering phase was estimated by comparing the dry matter status at 50% flowering and afterwards only 10-15% of the dry matter accumulated during pre-flowering and more than 85% accumulated during post-flowering phase (Table 2).

**Dry matter distribution**

The percentage distribution of dry matter at pre-flowering, post-flowering and maturity phases of growth (Table 3) shows that at pre-flowering 80-85% of the dry matter was in leaves and only 10-12% in the stem. By contrast, in the post-flowering phase, more than 41 to 55% was accumulated in the stem,

Table 1 : Changes in dry matter accumulation in leaves, stems and pods (g/m$^2$)

| Treatment | Leaves | | | | | | |
|---|---|---|---|---|---|---|---|
| | Days after sowing | | | | | | |
| | 35 | 50 | 65 | 80 | 95 | 110 | 125 |
| Irrigation | | | | | | | |
| Unirrigated | 47.3 | 104.5 | 118.1 | 101.2 | 108.7 | 85.2 | 38.5 |
| Irrigated | 54.7 | 135.5 | 179.6 | 168.7 | 143.3 | 109.4 | 56.5 |
| LSD (P=0.05) | NS | 21.1 | 41.1 | 42.7 | 27.4 | 140.0 | NS |
| Varieties | | | | | | | |
| Pusa Bold | 49.8 | 136.4 | 154.1 | 147.5 | 146.1 | 120.5 | 48.1 |
| Pusa Kalyani | 52.0 | 103.9 | 141.8 | 116.3 | 105.8 | 74.1 | 52.2 |
| LSD (P G. 05) | 5.6 | 7.4 | 9.8 | 8.3 | 10.3 | 7.2 | NS |
| Spacing (cm) | | | | | | | |
| 15 X 15 | 75.7 | 159.7 | 197.6 | 186.3 | 160.9 | 134.9 | 68.2 |
| 15 X 30 | 41.9 | 111.3 | 141.3 | 114.1 | 124.6 | 86.4 | 52.2 |
| 15 X 45 | 35.2 | 89.6 | 104.0 | 95.3 | 92.5 | 70.4 | 30.0 |
| LSD (P=0.05) | 6.8 | 9.0 | 12.0 | 10.0 | 12.5 | 8.8 | 6.4 |

Table 1 : (Contd.)

| Stem | | | | | | | |
|---|---|---|---|---|---|---|---|
| Days after sowing | | | | | | | |
| 35 | 50 | 65 | 80 | 95 | 110 | 125 | 140 |
| 9.2 | 53.1 | 209.1 | 366.6 | 409.4 | 390.6 | 421.6 | 391.8 |
| 8.5 | 74.6 | 339.3 | 564.3 | 670.4 | 660.8 | 705.5 | 648.1 |
| NS | 20.6 | 44.8 | 107.3 | 26.3 | 89.0 | 52.2 | 26.2 |
| 9.3 | 76.6 | 340.8 | 582.6 | 662.9 | 629.2 | 664.0 | 633.0 |
| 4.1 | 50.5 | 207.6 | 348.0 | 416.8 | 422.6 | 463.0 | 406.8 |
| NS | 9.0 | 13.7 | 14.7 | 17.0 | 8.1 | 18.9 | 20.7 |
| 15.0 | 163.0 | 301.1 | 524.5 | 605.6 | 587.8 | 631.9 | 560.3 |
| 6.5 | 54.4 | 235.3 | 418.3 | 468.1 | 445.3 | 490.3 | 456.0 |
| 4.8 | 33.2 | 286.1 | 453.3 | 545.9 | 519.7 | 568.2 | 543.2 |
| 1.3 | 10.9 | 16.7 | 17.9 | 20.7 | 19.9 | 22.8 | 24.4 |

Table : 1 (Contd.)

| Treatments | Pods | | | | | |
|---|---|---|---|---|---|---|
| | Days after sowing | | | | | |
| | 65 | 80 | 95 | 110 | 125 | 140 |
| Irrigation | | | | | | |
| Unirrigated | 34.3 | 40.1 | 224.9 | 391.0 | 585.8 | 683.0 |
| Irrigated | 34.1 | 54.4 | 300.7 | 432.4 | 704.8 | 803.8 |
| LSD (P = 0.05) | NS | NS | 23.1 | NS | 44.8 | 87.2 |
| Varieties | | | | | | |
| Pusa Bold | 33.5 | 54.4 | 275.8 | 486.8 | 691.6 | 803.0 |
| Pusa Kalyani | 36.5 | 40.1 | 234.9 | 336.6 | 599.0 | 684.9 |
| LSD (P = 0.05) | 3.6 | 4.6 | 16.8 | 29.6 | 21.0 | 25.7 |
| Spacings (cm) | | | | | | |
| 15 × 15 | 44.1 | 64.1 | 229.8 | 542.3 | 1093.4 | 1125.5 |
| 15 × 30 | 29.1 | 47.3 | 192.4 | 331.5 | 470.7 | 581.8 |
| 15 × 45 | 19.6 | 30.3 | 273.8 | 360.5 | 461.7 | 522.2 |
| LSD (P = 0.05) | 4.4 | 5.6 | 20.4 | 36.0 | 25.5 | 31.2 |

Table 1 : (Contd.)

| Total | | | | | | | |
|---|---|---|---|---|---|---|---|
| Days after sowing | | | | | | | |
| 35 | 50 | 65 | 80 | 95 | 110 | 125 | 140 |
| 56 5 | 157.6 | 359.4 | 499.2 | 740.2 | 876.2 | 1346.8 | 1074.8 |
| 63.3 | 210.3 | 551.4 | 784.0 | 1107.3 | 1195 7 | 1466.7 | 1475.8 |
| NS | 34.2 | 79.2 | 170.9 | 44.8 | 30.9 | 47 4 | 214.2 |
| 59.2 | 213.4 | 526.1 | 782.1 | 1099.3 | 1236.6 | 1403.6 | 1460.5 |
| 60.5 | 154.4 | 384.6 | 504.0 | 749.0 | 833.4 | 1109.2 | 1090.2 |
| 3.6 | 13.1 | 17.8 | 20.8 | 16.0 | 34.7 | 26.2 | 43.1 |
| 90.9 | 262.8 | 553.0 | 774.2 | 1088.2 | 1265.3 | 1703.8 | 1722.7 |
| 48.5 | 166.1 | 405.9 | 579.0 | 785.3 | 874.0 | 1002.3 | 1037.8 |
| 40.2 | 122.8 | 407.3 | 576.9 | 898.9 | 975.7 | 1064.3 | 1065.8 |
| 6.5 | 16.0 | 21.6 | 25.3 | 19.5 | 42 2 | 31 5 | 52.1 |

Table 2 : **Percentage accumulation of dry matter at pre- and post-flowering**

| Treatments | Pre-flowering | Post-flowering |
|---|---|---|
| Irrigation | | |
| Unirrigated | 14.6 | 85.4 |
| Irrigated | 14.2 | 85.8 |
| Varieties | | |
| Pusa Bold | 14.5 | 85.5 |
| Pusa Kalyani | 14.1 | 85.9 |
| Spacing (cm) | | |
| 15 × 15 | 15.2 | 84.8 |
| 30 × 15 | 16 0 | 84.0 |
| 45 × 15 | 11.5 | 88.5 |

Table 3 : Per cent distribution of dry matter to various plant parts

| Treatments | Pre-flowering | | | Post-flowering | | | Maturity | | |
|---|---|---|---|---|---|---|---|---|---|
| | Leaves | Stem | Pods | Leaves | Stem | Pods | Leaves | Stem | Pods |
| Irrigation | | | | | | | | | |
| Unirrigated | 83.7 | 16.3 | — | 9.8 | 45.1 | 45.1 | — | 36.4 | 63 6 |
| Irrigated | 86.5 | 13.5 | — | 9.1 | 54.9 | 36.0 | — | 44.6 | 55.4 |
| Varieties | | | | | | | | | |
| Pusa Bold | 84.2 | 15.8 | — | 9.7 | 51.8 | 38.5 | — | 44.1 | 55.9 |
| Pusa Kalyani | 86.1 | 13.9 | — | 8.9 | 50.7 | 40.4 | — | 37.3 | 62.7 |
| Spacings (cm) | | | | | | | | | |
| 15 × 15 | 83.4 | 16.6 | — | 10.6 | 46.4 | 43.0 | — | 33.2 | 66.8 |
| 30 × 15 | 86.6 | 13.4 | — | 10.0 | 51.6 | 38.4 | — | 43.9 | 56,1 |
| 45 × 15 | 87.8 | 12.2 | — | 7.4 | 54.6 | 38.3 | — | 50,9 | 49.1 |

35 to 43% in the pods and 7 to 8% in the leaves. The low percentage in leaves was due to partial leaf senescence on one hand and the development of the pods on the other. At maturity it was observed that stems and pods accounted for approximately 43 to 51% and 48 to 57% dry matter respectively.

With changing populations the proportion of dry matter accumulated in different plant parts showed that irrespective of the stage of development, dry matter of vegetative organs, namely leaf and stem increased with increased spacing from 15 × 15 to 45 × 15 cm. With pods the trend was reversed; narrow spacing (15 × 15 cm) showing the highest and wide spacing (45 × 15 cm) the lowest, proportion of dry matter. This appeared to be a factor contributing to the relatively higher yields of dense plantings.

**Growth parameters**

Irrespective of treatments, leaf area increased upto 65 days after sowing, attaining a maximum LAI of 3-5 depending on the treatment. LAI of narrow spaced crops (Fig. 1) was greater than that of wider rows. The LAI after 65 days was almost doubled in close planting (15 × 15 cm spacing) indicating higher LAI can be achieved by increasing the planting density.

Results of Fig. 1 show that NAR was high at early stages of growth and decreased gradually with an upswing between 80-95 days. In the early stages NAR was highest under low population density and lowest under high population density.

Relative growth rate (RGR) followed the same trend as NAR. In general, plants grown under wider spacing or low density had relatively higher growth rate.

Crop growth rate (CGR) was low in the beginning and increased upto 80 to 95 days with a fall in the period between 65 and 80 days which coincided with the period of declining LAI (Fig. 1). Again between the 95th to 100th day there was a sharp increase in the level of CGR probably due to rapidly maturing pods. Plant density significantly affected CGR which had greatest values with higher population density and lowest with lower population density. The higher values may be due to larger leaf area index as noted earlier.

## DISCUSSION

The proportion of dry matter in various plant parts namely, leaves, stems and pods was significantly influenced by irrigation. Similarly dry matter/m$^2$

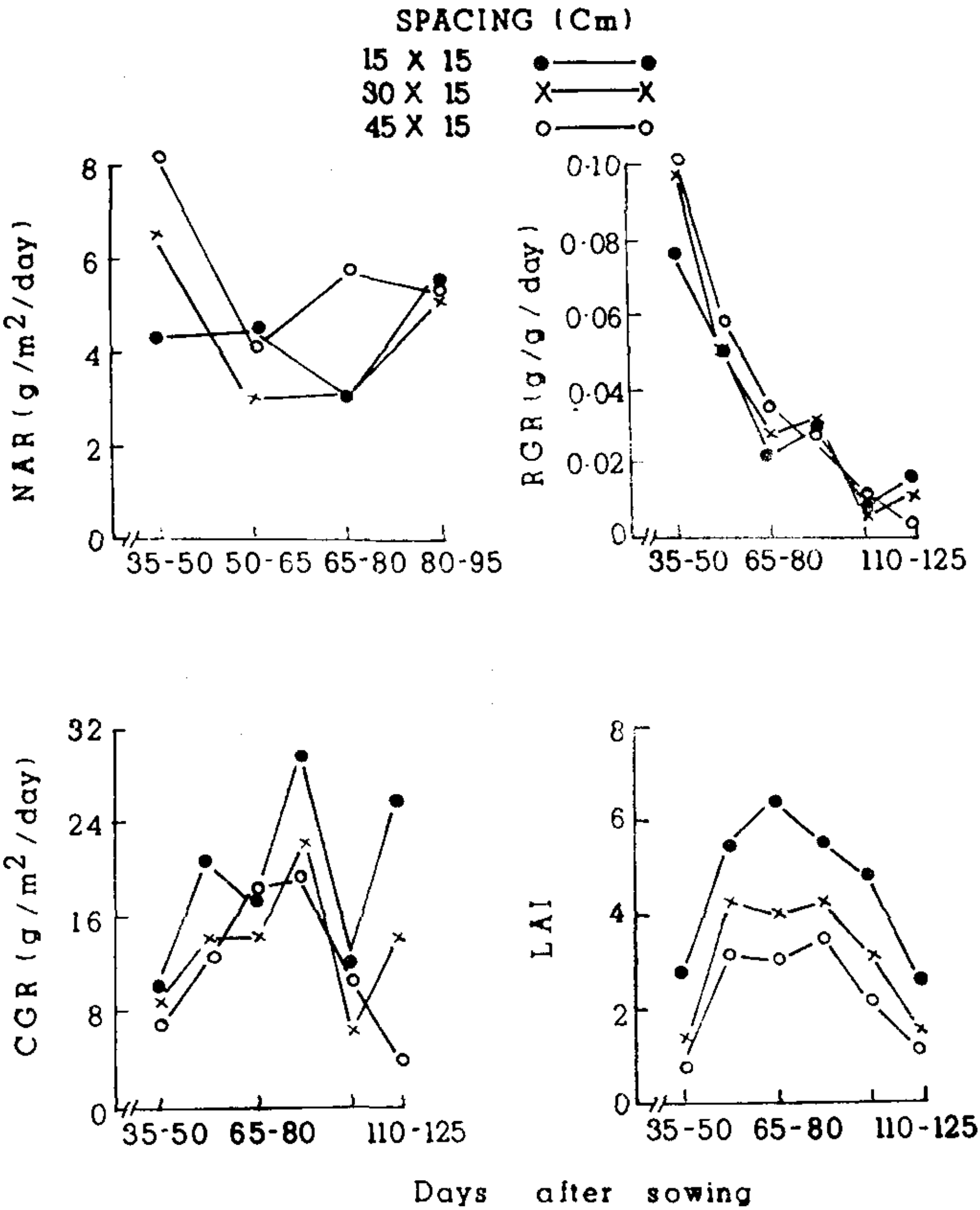


**Fig. 1** : Effects of spacing on mean net assimilation rate (NAR), relative growth rate (RGR), crop growth rate (CGR) and leaf area index (LAI) irrespective of cultivars, 1981-82

increased with increasing plant density from the early stages of growth. However, there was no significant difference between 30 × 15 and 45 × 15 cm spacing. Therefore, it is clear that both competition and compensation mechanisms operate whereby a small population of 15 plants could perform as well as 22 plants/m$^2$. Thus three fold increase in plant density (15 X 15 cm) clearly increased LAI, CGR and dry matter production which indirectly reflected on yield. In Britain, Scarisbrick *et al* (1981) obtained a total dry matter yield of 1100 g/m$^2$ or less at a plant density of 160 plants/m$^2$. However, Clarke and Simpson (1978) in Canada reported a dry matter yield of 1920 g/m$^2$ and 3200 g/m$^2$ under irrigated and rainfed conditions respectively at plant density of 300 plants/m$^2$. These are possibly some of the highest dry matter yields reported in *Brassica* species. The data of Clarke and Simpson (1978) further showed maximum CGR values of 80 g/m$^2$/ day when LAI was 6 under irrigated conditions. In the present study a comparable LAI was obtained but CGR was about one third and dry matter production was only half (Fig. 1). Obviously limitation in LAI could not be the cause of poor dry matter production under our conditions. Possibly two factors could account for these differences. Firstly the total sunlight hours received in Saskatchewan, Canada (53°20' N) is much more than what is obtained in Delhi (28°42' N). The second possibility is that temperature regime is such that it causes a high CGR for a longer duration.

Another interesting feature of crop growth in Delhi was that only 10-15% of the total dry matter accumulated before flowering; similar observation was made by Chauhan (1980). After anthesis, the dry weight of the plant increased largely because of pod growth, inspite of declining LAI. In addition, there was no drop in CGR at high LAI indicating that there was no excessive production of leaf area. Net assimilation rate (NAR) was highest in low plant population density especially during the early part of the season. It is quite possible that plants under high density would have faced mutual shading resulting in reduced photosynthesis per unit leaf area (Watson 1958). Interestingly, NAR increased during seed ripening, probably due to pod wall photosynthesis coupled with increased sink demand (Clarke and Simpson, 1978; Allen and Morgan, 1972, 1975).

The following conclusions can be derived from the present study. Dry matter production in *Brassica* species can be increased by irrigation and increasing plant population at least upto 44 plants/m$^2$. Increased dry matter production under high population density is directly linked with high LAI.

**ACKNOWLEDGEMENT**

The senior author would like to thank the authorities of Indian Agricultural Research Institute, New Delhi, for providing financial support during the tenure of the present investigation.

## LITERATURE CITED

ALLEN, E. J. and MORGAN, D. G. 1972. A quantitative analysis of the effects of nitrogen on the growth, development and yield of oilseed rape. *J. Agric. Sci.* 78 : 385-24.

ALLEN, E. J. and MORGAN, D. G. 1975. A quantitative comparison of the growth development and yield of different varieties of oilseed rape. *J. Agric. Sci.* 85 : 159-174.

BHARGAVA, S. C. and TOMAR, D. P. S. 1982. Physiological basis of yield improvement in rapeseed-mustard. Proceedings of Indo-Swedish joint workshop on rapeseed-mustard. Department of Science and Technology, New Delhi : 33-41.

CHAUHAN, Y.S. 1980. Physiological investigations on productivity of *Brassica* ecotypes. Ph. D. thesis. Indian Agricultural Research Institute, New Delhi, India.

CLARKE, J. M. and SIMPSON, G. M. 1978. The influence of irrigation and seeding rates on yield and yield components of *Brassica napus*. *Can. J. Pl. Sci.* 58 : 731-737.

RADFORD, P.J. 1967. Growth analysis formulae : their use and abuse. *Crop Sci.* 7 : 171-175.

SCARISBRICK, D. H., DANIELS, R. W. and NOOR RAWI. 1982. The effect of varying seed rate on the yield and yield components of oilseed rape (*B. napus*). *J. Agric. Sci.* 81 : 277-286.

THURLING, N. 1974. Morphological determinants of yield in rapeseed *Brassica campestris* and *Brassica napus*). I. Growth and morphological characters. *Aust. J. Agric. Res.* 75 : 697-710.

WATSON. D. J. 1978. The dependence of net assimilation rate on leaf area index. *Ann. Bot. N. S.* 22: 37-54.

J. Oilseeds Res. 1(1984) : 49-56

# Response of *Brassica* varieties sown on different dates to the attack of mustard aphid *Lipaphis erysimi* (Kalt.)

**Harvir Singh, H. R. Rohilla, V. K. Kalra and T. P. Yadava***
Department of Plant Breeding (Oilseeds Section),
Haryana Agricultural University, Hissar 125 004, India

## ABSTRACT

The performance of three varieties of (Brassica juncea) viz. Prakash, RH-30 and Varuna and two of rapeseed (Brassica campestris var. brown sarson) viz., BSH-1 and Pusa Kalyani sown at four different sowing dates was studied against the attack of mustard aphid, Lipaphis erysimi (Kalt.) for four years (1976-77 to 1979-80). Mustard varieties showed higher tolerance against the aphid infestation as compared to rapeseed varieties. The crops sown ten to fifteen days in advance to the normal sown crops escaped aphid infestation without any reduction in the yield, whereas ten to thirty days late sown crops were heavily infested and suffered considerable yield losses. Therefore, selection of a good variety from B. juncea group and sowing in the first week of October are suggested as effective and economical ways of combating this serious pest of rapeseed and mustard crops

**Key Words :** *Brassica juncea*; brown sarson; mustard aphid; *Lipaphis erysimi*; sowing date

## INTRODUCTION

Rapeseed and mustard are the major Rabi oilseed crops of India. During 1980-81, these crops occupied 3.56 lakh ha area with a production of 1.88 lakh tonnes. The average production of these crops is quite low in India because of the fact that a large number of insect-pests attack them (Rai,1976). Among various insect-pests, mustard aphid, *Lipaphis erysimi* (Kalt.) is the most important and a limiting factor in the successful cultivation of these crops. So far attempts have been made to control mustard aphid with regular application of insecticides without any consideration to their hazardous effects on useful insects and environment. The present investigations were undertaken to

Received for publication on November 30, 1983

* Present address : Project Director, Directorate of Oilseeds Research, Rajendranagar, Hyderabad 500 030.

find out the ways for the management of this pest through some changes in sowing dates and adoption of tolerant varieties of *Brassica* without reduction in yield and increase in cost of cultivation.

## MATERIALS AND METHODS

Present studies were conducted at the experimental farm of Haryana Agricultural University, Hissar for four years (1976-77 to 1979-80). The experiments were laid out in split plot design with a plot size of 3m × 4.5m and replicated thrice. Five varieties viz. BSH 1 and Pusa Kalyani belonging to rapeseed (*Brassica campestris* var. brown sarson) group and Prakash, RH-30 and Varuna belonging to mustard (*B. juncea*) group were selected. Four sowing dates at an interval of 10-15 days i.e. early ($D_1$; 4th to 9th October), normal ($D_2$; 18th to 19th October) and two late ($D_3$; 28th October to 4th November and $D_4$; 7th to 19th November), between early October and mid November were tried (Table 2). All the crops were grown under recommended agronomical practices. Observations on aphid population were started 40 days after each sowing date and continued till harvest. The data on mustard aphid population were recorded at one month interval during 1976-77 and 1977-78, and at 15 days interval during 1979-80. During 1978-79 no data could be collected because of very low aphid infestation. Aphid population was recorded on 10 cm long central twigs of 10 randomly selected plants per plot. The aphids were removed with the help of camel hair brush and counted volumetrically (0.2 ml. increase in the volume of water was equivalent to 1000 aphids) or by absolute count method depending upon the number.

## RESULTS AND DISCUSSION

**Effect of varieties :**

The data presented in Table 1 show that the mustard aphid attack was significantly higher on varieties of *Brassica campestris* group as compared to those of *B. juncea* group. During 1976-77 the maximum aphid population recorded in the end of February was on Pusa Kalyani (2524.17 aphids/twig) followed by BSH 1 (1478.75 aphids/twig), whereas 622.67 and 652.50 aphids/twig were observed on RH 30 and Prakash, respectively. Similar results were recorded during the year 1977-78. The year 1979-80 was a lean year for the incidence of mustard aphid. The aphids appeared quite late in the season (in the first week of January) and remained upto first week of March. Nevertheless, similar trend of aphid incidence was observed as in the earlier years. BSH 1 harboured maximum number of aphids (553.11/twig) as compared to Varuna, RH-30 and Prakash. Among the *B. juncea* group of varieties, RH 30 and Varuna harboured less number of aphids i.e. 20.0 and 10.0 aphids/twig, respectively as against 277.81 aphids/twig in the variety Prakash.

Table 1 : Response of different *Brassica* varieties to aphid infestation (combined effect of all sowing dates)

| Dates of observation | Av. number of aphids per twig | | | | C.D. at (5%) |
|---|---|---|---|---|---|
| | BSH-1 | Pusa Kalyani | RH-30 | Prakash | |
| a) 1976—77 | | | | | |
| 27-11-76 | 20.80 (3.47) | 25.00 (3.87) | 0.00 (1.00) | 0.00 (1.00) | (0.34) |
| 27-12-76 | 821.25 (28.63) | 747.92 (27.30) | 18.75 (3.24) | 44.17 (5.19) | (0.75) |
| 27-01-77 | 1101.67 (33.25) | 1030.00 (32.07) | 97.50 (8.51) | 112.92 (10.21) | (0.82) |
| 27-02-77 | 1478.75 (38.14) | 2524.17 (47.91) | 622.67 (23.79) | 652.50 (25.84) | (3.40) |
| b) 1977—78 | | | | | |
| 30-11-77 | 140.84 (6.50) | 220.42 (7.24) | 2.09 (1.42) | 95.67 (4.94) | (N.S.) |
| 31-12-77 | 1238.75 (27.84) | 936.25 (25.14) | 151.67 (8.38) | 556.67 (18.39) | (8.20) |
| 31-01-78 | 1516.00 (38.18) | 1737.13 (37.29) | 871.87 (27.72) | 402.22 (18.07) | (2.23) |
| c) 1979—80 | | | | | |
| | BSH 1 | Varuna | RH 30 | Prakash | |
| 9-01-80 | 25.93 (3.67) | 3.52 (1.51) | 2.81 (1.60) | 0.00 (1.00) | (1.34) |
| 24-01-80 | 58.75 (6.37) | 8.43 (2.27) | 15.43 (3.34) | 0.00 (1.00) | (1.55) |
| 7-02-80 | 197.50 (10.61) | 20.93 (3.19) | 29.68 (4.17) | 23.43 (2.90) | (2.79) |
| 18-02-80 | 447.50 (14.20) | 65.62 (5.78) | 207.81 (9.67) | 262.50 (12.94) | (3.07) |
| 1-03-80 | 533.11 (17.43) | 110.00 (7.49) | 90.00 (7.42) | 277.81 (12.61) | (4.15) |

Figures in parentheses are $\sqrt{n+1}$ values

It can be concluded from these results that the aphids appeared early on *B. campestris* varieties and multiplied at faster rate while it appeared late on *B. juncea* varieties and multiplied at slower rate because of the fact that rapeseed varieties flowered earlier than the mustard. These findings are similar to those of Pathak (1961) Kundu and Pant (1967) and Pal *et al.* (1976). Prasad and Phadke (1980) also observed that the varieties of *B. campestris* in which the flowering was early harboured more aphids while the varieties of *B. juncea* in which the flowering was late escaped the aphid attack.

**Effect of date of sowing**

The data in Table 2 reveal that irrespective of the varieties, the sowing dates had significant effect on aphid incidence. The crops sown 10-15 days early ($D_1$, 4th to 9th October) harboured lower aphid population (996.34 aphids/twig) as compared to the crops sown on later dates i.e. $D_3$, 28th October to 4th November and $D_4$, 7th to 19th November with 1648.34 and 1848.34 aphids/twig, respectively during 1976-77. Similar trend was recorded during 1977-78 and 1979-80. Irrespective of varieties the aphid infestation increased with delayed sowings. All the varieties, during all the years of experimentation, had minimum aphid infestation when sown 10-15 days earlier than normal sowing. Reverse was true with delayed sowings.

Rapeseed and mustard suffered maximum damage due to aphids during flowering period i.e. end of December. Therefore, early sown crops escaped infestation because, flowering was over and the plants became hardy before the peak period of aphid infestation. Kundu and Pant (1968) also observed that aphid damage was more in the early stage of the plant growth. Flowering stages in the normal and late sown crops coincided with peak period of aphid infestation i.e. end of January to end of February. There were more number of aphids per plant in the crops sown on the last date. Possibly the aphids concentrated on late sown crops, reason being, the only crop in flowering stage. Present findings are in agreement with those of Bhattacharjee, 1961; Tripathi and Singh, 1969, who also observed low and high aphid infestation on early and late sown *Brassica* crops, respectively.

**Yield**

It is clear from the data (Table 3) that the varieties Prakash and RH 30 gave higher yields (av. 2005 and 2061 kg/ha, respectively) during 1976-77, irrespective of the date of sowing. These yields were significantly higher than those of BSH 1 (516 kg) and Pusa Kalyani (1186 kg). Similar results were obtained in the following years i.e. 1977-78 and 1979-80. Yields obtained during

Table 2 : Effect of different sowing dates on aphid infestation (combined effect of all the varieties)

| Date of observations | Date of sowing $D_1$ | $D_2$ | $D_3$ | $D_4$ | C.D. at (5%) |
|---|---|---|---|---|---|
| a) 1976—77 | 8-10-76 | 18-10-76 | 28-10-76 | 7-11-76 | |
| 27-11-76 | 37.09 (4.91) | 7.09 (2.43) | 0.00 (1.00) | 0·00 (1.00) | (0.37) |
| 27-12-76 | 432.09 (17.36) | 469.59 (19.05) | 370.42 (14.50) | 360.00 (13.93) | (1.11) |
| 27-01-77 | 611.25 (22.99) | 596.25 (22.58) | 575.84 (20.19) | 558.75 (17.21) | (0.81) |
| 27-02-77 | 996.34 (29.42) | 784.59 (26.94) | 1648.34 (37.31) | 1848.34 (42.31) | (4.04) |
| b) 1977—78 | 4-10-77 | 19-10-77 | 4-11-77 | 19-11-77 | |
| 30-11-77 | 459.00 (17.16) | 0.00 (1.00) | 0.00 (1.00) | 0.00 (1.00) | (2.52) |
| 31-12-77 | 1130.42 (29.72) | 281.25 (15.70) | 1471.67 (33.97) | 0.00 (1.00) | (8.24) |
| 31-01-78 | 764.79 (21.91) | 902.92 (28.83) | 1556.39 (35.09) | 1303.12 (35.49) | (1.50) |
| c) 1979—80 | 9-10-79 | 19-10-79 | 29-10-79 | 8-11-79 | |
| 9-01-80 | 7.50 (2.19) | 7.50 (2.19) | 13.37 (2.77) | 0.00 (1.00) | (N.S.) |
| 24-01-80 | 3.56 (1.52) | 11.25 (2.49) | 38.43 (4.91) | 29.37 (4.10) | (1.11) |
| 7-02-80 | 1.37 (1.27) | 16.25 (3.06) | 95.00 (7.85) | 155.93 (8.69) | (4.09) |
| 18-02-80 | 1.25 (1.22) | 21.25 (3.03) | 273.43 (14.55) | 683.50 (24.40) | (4.15) |
| 1-03-80 | 1.56 (1.33) | 45.31 (5.45) | 272.81 (13.69) | 711.25 (24.40) | (3.55) |

Figures in parentheses are $\sqrt{n+1}$ values

**Table 3** : Response of different dates of sowing on yield (kg/ha) of different *Brassica* varieties

| Varieties | Dates of sowing | | | | Av. |
|---|---|---|---|---|---|
| | $D_1$ | $D_2$ | $D_3$ | $D_4$ | |
| a) 1976-77 | (8-10-76) | (18-10-76) | (28-10-76) | (7-11-76) | |
| BSH 1 | 669 | 667 | 583 | 156 | 516 |
| Pusa Kalyani | 1414 | 1489 | 1333 | 511 | 1186 |
| RH 30 | 2467 | 2133 | 2011 | 1633 | 2061 |
| Prakash | 3078 | 2367 | 1356 | 1222 | 2005 |
| Av. | 1907 | 1664 | 1320 | 880 | |
| | C. D. at 5% for date of sowing = 133.0 | | | | |
| | C. D at 5 % for varieties = 099.0 | | | | |
| b) 1977-78 | (4-10-77) | (19-10-77) | (4-11-77) | (19-11-77) | |
| BSH 1 | 324 | 218 | 194 | 32 | 192 |
| Pusa Kalyani | 358 | 448 | 272 | 22 | 317 |
| RH 30 | 1055 | 667 | 570 | 133 | 606 |
| Prakash | 1164 | 1115 | 800 | 76 | 788 |
| Av. | 775 | 612 | 451 | 65 | |
| | C. D. at 5% for date of sowing = 07.90 | | | | |
| | C. D. at 5% for varieties = 12.60 | | | | |
| c) 1979-80 | (9-10-79) | (19-10-79) | (29-10-79) | (8-11-79) | |
| BSH 1 | 1362 | 838 | 771 | 525 | 873 |
| Varuna | 1981 | 1638 | 1257 | 1029 | 1476 |
| RH 30 | 2029 | 1752 | 1343 | 1048 | 1543 |
| Prakash | 1981 | 1752 | 1276 | 638 | 1411 |
| Av. | 1838 | 1495 | 1161 | 809 | |
| | C. D. at 5% for date of sowing = 398.0 | | | | |
| | C. D. at 5% for varieties = 169.0 | | | | |

1977-78 were quite low (Table 3) because of heavy incidence of hairy caterpillar (*Diacrisia obliqua*), frost and untimely rains during February. Even then, the early sown crops escaped a bit of these effects, while the late sown crops performed very badly with average yield of 65 kg/ha irrespective of the varieties. During 1979-80, the variety Varuna yielded significantly higher (1476 kg/ha) than BSH 1 (873 kg/ha) confirming the higher yield potential of the varieties of *B. juncea* group.

Regarding date of sowing, the crops sown early ($D_1$; 4th to 9th October) yielded the highest (1907 kg/ha) during 1976-77, irrespective of the varieties of different *Brassica* groups. This was followed by the normal ($D_2$; 18th to 19th October) sown crops (1664 kg/ha). The late sown crops ($D_3$; 28th October to 4th November and $D_4$; 7th to 19th November) yielded significantly lower (1321 and 880 kg/ha, respectively) than the early and normal sown crops. The results obtained during the succeeding years i. e. 1977-78 and 1979-80 also confirmed the first year's results. Therefore, the selection of a good variety from *B. juncea* group and sowing in the first week of October can help to combat this pest effectively and economically.

**ACKNOWLEDGEMENT**

The authors are thankful to the Indian Council of Agricultural Research, New Delhi, India for providing financial help to carry out this project.

**LITERATURE CITED**

BHATTACHARJEE, N. S. 1961. Control of mustard aphid by cultural practices. *Indian Oilseeds J.* 5 : 133-138.

KUNDU, G. G. and PANT, N. C. 1967. Studies on *Lipaphis erysimi* with special reference to insect plant relationship. I. Susceptibility of different varieties of *Brassica* and *Eruca sativa* to mustard aphid infestation. *Indian J. Ent.* 29 : 241-251.

KUNDU, G. G. and PANT, N. C. 1968. Studies on, *Lipaphis erysimi* with special reference to insect plant relationship. II. Effect of age of plants on susceptibility. *Indian J. Ent.* 30 : 169-172.

PAL, S. R., NATH, D. K. and SAHA, G. N. 1976. Effect of time of sowing and aphid infestation on rai (*Brassica juncea* Coss). *Indian Agri.* 20 : 27-34.

PATHAK, M. D. 1961. Preliminary notes on the differential response of yellow and brown sarson and rai to mustard aphid (*Lipaphis erysimi* Kalt.) *Indian Oilseeds J.* 5 : 39-44.

**PRASAD, Y. K.** and PHADKE, K. G. 1980. Population dynamics of *Lipaphis erysimi* (Kalt.) on different varieties of *Brassica* species. *Indian J. Ent.* 42 : 54-63.

**RAI, B. K.** 1976. Pests of oilseeds crops in India and their control. Indian Council of Agricultural Research pp. 121.

**TRIPATHI,** R. L. and SINGH, V. S. 1964. Effect of sowing date variations on the incidence of mustard aphid, *Lipaphis erysimi* Kalt. on *Brassica campestris* var. sarson (brown and yellow) and *B. juncea*. *Indian J. Ent.* 26 : 251 252.

J. Oilseeds Res. 1(1984) : 57-62

# Combining ability and genetic architecture of protein content in Indian mustard

**Parkash Kumar, T. P. Yadava*, S. K. Gupta and Kamal Dhawan**
Haryana Agricultural University, Regional Reserach Station, Bawal, Haryana.

## ABSTRACT

Nine genotypes of Indian mustard representing a wide spectrum with respect to morphological and biochemical attributes were crossed in half diallelic fashion to study the inheritance of protein content. Both additive and non-additive genetic components were observed to be operative for its inheritance. Three parents namely Yellow rai K 1, RH 30 and RC 423 exhibited significant positive gca effects and the use of these parents in future breeding programme is advocated. A few cross combinations also showed significant positive sca effects for protein content. Intermating of selects in early segregating generations is also suggested in order to exploit the available genetic components.

**Key words :** Combining ability; Genetic architecture; Indian mustard

## INTRODUCTION

Rapeseed and mustard are unique in a way that they are concentrated packages of fats and proteins of the type not available through services in nature. In India, oil is mainly consumed for domestic purposes whereas cake locally known as 'khal' is used as an animal feed which contains about 40-45% protein. Since rapeseed and mustard proteins play an important role in nutrition of animals as well as human beings, it is quite comparable with soybean protein. Keeping in view, the importance of mustard protein, present study was initiated to know its genetic architecture without which it may not be possible to formulate an effective and efficient breeding methodology.

## MATERIALS AND METHODS

Nine genotypes namely, RH 30, Prakash, Yellow rai K 1, RH 785 RC 1426, RC 1425, RH 780, RC 423 and RC 781 differing in morphological

---

Received for publication on December 8, 1983

Present address : Project Director, Directorate of Oilseeds Research, Rajendranagar, Hyderabad-500 030

and bio-chemical characteristics were crossed in all possible combinations (excluding reciprocals). 36 $F_1$ hybrids alongwith their 9 parents were grown in randomised block design with three replications. The progenies including parents and $F_1$'s were sown spacing 45 cm × 15 cm between and within rows, respectively. The bulk seed sample of each progeny collected at the time of harvesting from all the replications was utilized to analyse protein content as per specifications outlined in AOAC(1961). The angular transformed data were further utilised for statistical analysis. The analysis of combining ability variances and effects were done according to Griffing's (1956) method II model I. The estimates of genetic components namely D, $H_1$, $H_2$, $h^2$ F and E alongwith different ratios were obtained using the method suggested by Hayman (1954).

## RESULTS AND DISCUSSION

The analysis of variance indicated the presence of sufficient amount of genetic variability with respect to protein content among the progenies including parents and $F_1$'s. The mean sum of squares due to general and specific combining ability (gca; sca) were significant (Table 1).

Table 1 : Analysis of variance for combining ability for protein content in Indian mustard

| Source | d.f. | Mean sum of squares |
|---|---|---|
| General combining ability | 8 | 2.08* |
| Specific combining ability | 36 | 1.03* |
| Error | 88 | 0.043 |
| $6^2g$ | 0.185 | |
| $6^2s$ | 0.987 | |
| $6^2s/6^2g$ | 5.33 | |

* Significant at P = 0.05%

As it is clear from the expectations of general and specific combining ability in Griffing's analysis that mean squares do not provide a clear picture of relative magnitude of additive and non-additive genetic components, the unbiased variances due to both general ($6^2g$) and specific ($6^2s$) combining ability were estimated. The results indicated the presence of both additive ($6^2g$) and non-additive ($\sigma^2$s) genetic components, and the magnitude of latter was nearly 5 times higher than the former.

The estimates of D, $H_1$, $H_2$, $h^2$, F and E along with different proportions have been presented in Table 2. The genetic parameter, D, which measures the variance due to additive genetic effects was significant. $H_1$, which measures the variance due to dominance component was also significant. Between the two

Table 2 : Estimates of genetic components and their ratios for protein content in Indian mustard

| Components | | Ratios | |
|---|---|---|---|
| D | 1.13* ±0.33 | $(H_1/D)^{1/2}$ | 2.09 |
| $H_1$ | 4.93* ±0.73 | $H_2/4H_1$ | 0.18 |
| $H_2$ | 3.40 ± 0.63 | $\frac{(4DH_1)^{1/2}+F}{(4DH_1)^{1/2}-F}$ | 2.08 |
| $h^2$ | 0.003±0.279 | $h^2/H_2$ | 0.008 |
| F | 1.65 ±0.77 | Heritability (NS) | 24.69 |
| E | 4.33 ±0.10 | | |

* Significant at $P < 0.05$

components, the magnitude of $H_1$ was relatively higher than the corresponding D components. Further, the ratio $(H_1/D)^{1/2}$, which measures the average degree of dominance also confirmed the presence of over-dominance. This indicated that protein content in Indian mustard is largely under the influence of non-additive genetic component. Contrary to the present findings, Grami and Steffensson (1977) observed that protein in Summer rape is exclusively under the control of additive gene action. The positive significant value of F indicated the presence of more number of dominant genes involved in its inheritance. It was further confirmed when the ratio$(4DH_1)^{1/2}+F$ and $(4DH_1)^{1/2}-F$ attained the value of 2.08, which indicated that for every one recessive gene there were at least two dominant genes. The ratio of $H_2$ and$4H_1$ was observed to be deviating from the theoretical value of 0.25, revealing thereby the asymmetrical distribution of positive and negative genes among the parents entering crosses. The ratio h2/H2 was unexpectedly very low which might have been underestimated because of the

Table 3 : Estimates of general (diagonal) and specific (above diagonal) combining ability effects for protein content in Indian mustard

| Parents | RH 30 | Prakash | Yellow rai K 1 | RH 785 | RC 1426 | RC 1425 | RH 780 | RC 423 | RC 711 |
|---|---|---|---|---|---|---|---|---|---|
| RH 30 | 0.482* | 1.863* | 0.862* | 0.731* | —0.184 | 1.231* | —0.127 | 0.944* | —1.467* |
| Prakash | | 0.089 | —0.552* | —0.676* | —1.478* | —0.560 | —0.167 | 1.304* | 0.443 |
| Yellow rai K 1 | | | 0.734* | —1.020* | —1.206* | 0.669* | 0.805* | —0.778* | 0.595* |
| RH 785 | | | | 0.342 | 2.077* | 0.455 | —0.253 | —0.845* | —0.579* |
| RC 1426 | | | | | —9.407* | 0.770* | —0.138 | 0.470 | 0.419 |
| RC 1425 | | | | | | —0.075 | —0.137* | 0.091 | —0.097 |
| RH 780 | | | | | | | —0.840 | —1.270* | —0.771* |
| RC 423 | | | | | | | | 0.235* | —0.247 |
| RC 781 | | | | | | | | | —0.624* |

S. E. (gi) = 0.06 S. E. (gi-gj) = 0.09 S. E. (sij-sik) = 0.27

*Significant at P = 0.05.

presence of complementary genes. Therefore, no valid interpretations with respect to the number of genes or gene groups exhibiting dominance could be made. The heritability in narrow sense was observed to be 24.69 per cent.

The estimation of general and specific combining ability with respect to parents and $F_1$ crosses respectively would be of immense use for the enhancement of genetic material (Table 3). The parents Yellow rai K 1 exhibited highest gca effects followed by parents RH 3 and RC 423 for protein content. A significant positive association of gca effects and array means was observed but on the contrary, no association was recorded between gca effects and *per se* performance. The results with respect to the absence of correlation between general combining ability and *per se* performance were also confirmed by several workers (Nanda and Gupta, 1967; Yadava and Gupta, 1975). It is, therefore, suggested to use the above good combining parents in future breeding programme for the development of varieties possessing good quality of meal.

An evaluation of specific combining ability revealed that only 11 cross combinations RH 30 × Prakash, RH 31 × Yellow rai K 1, RH 30 × RH 785, RH 31 × RC 1425, RH 30 × RC 423, Prakash × RC 423, Yellow rai K 1 × RC 1425, Yellow rai K 1 × RC 781, Yellow rai K 1 × RC 781, RH 785 × RC 1426, RC 1426 × RC 1425 exhibited significant positive sca effect for protein content. The cros RH 785 × RC 1426 possessed highest sca effects (2.077) whereas the minimum significant positive sca effects were recorded by a cross Yellow rai K 1 × RC 781 (0.598). Rest of the crosses possessing significant positive sca effects were midway between these two extremes. It was also observed that all the above promising crosses, except for two crosses RH 785 × RC 1426 and RC 1426 × RC 1425, resulted from at least one good combining parent revealing thereby, the predominance of additive × additive and / or additive × dominance type of genic interaction in these cross combinations. Regarding the high sca effects of RH 785 × RC 1426 and RC 126 × RC 1425, it is expected that they might have arisen purely from the presence of genic interaction. However, sometimes different genes or gene groups present separately in parents (i.e. RH 785, RC 1425 and RC 1426) nick well when brought together.

It was concluded from the results obtained from combining ability, and component analysis that the fixable and non-fixable components of genetic variances are important for the inheritance of protein content in Indian mustard. But the major role of non-additive genetic component cannot be ignored because of its higher magnitude as indicated by all the analysis under consideration. Therefore, it looks very desirable to formulate a breeding methodology which may mop up the fixable gene effects and at the same time maintain considerable amount of heterozygosity for exploiting the dominance effect. Intermating of selects in early segregating generations appears to be worth utilizing for exploiting simultaneously the fixable and non-fixable gene effects. Further, the undesirable linkages are also likely to break and subsequently may result in the establishment of desirable recombinants.

## LITERATURE CITED

AOAC. 1961. Official methods of analysis of the Association of Official Agricultural Chemists, 7th ed. pp. 12, Washington DC.

GRAMI, B. AND STEFENSSON, B.R.1977. Gene action for protein and oil content in Summer rape. *Can. J. Pl. Sci.* 57 : 625-631.

GRIFFING, B. 1956. Concept of general and specific combining ability in relation to diallel crossing system. *Aust. J. Biol. Sci. 9* : 469-493.

HAYMAN, B. I. 1954. The theory and diallel crosses. *Genetics 39* : 789-809.

JINKS, J. L. AND HAYMAN, B. I. 1953. The analysis of diallel cross in maize. *Genetics Newsletter* 27:48-54.

NANDA, G. S. AND GUPTA, V. P, 1967. General vs specific combining ability in diverse types of Pearl millet. *J.Res. P.A.U. 4:* 343-347.

YADAVA, T.P. AND GUPTA, V.P. 1957. Heterosis and genetic architecture for oil content in mustard. *Indian J. Genet. 35* : 143-155.

J. Oilseeds Res. 1(1984) : 63-69

# The effects of peg removal on the vegetative and reproductive parts of groundnut

**A. Narayanan, Baskara Reddy and S. R. K. Murthy**
Department of Plant Physiology, Agricultural College
A. P. Agricultural University, Bapatla-522 101, India

## ABSTRACT

Removal of pegs was carried out for one week from the onset of flowering in six cultivars of groundnut grown in the field during the monsoon season (July) of 1978 at Hyderabad. As soon as the crop attained maturity the vegetative and reproductive parts were sampled, counted and/or weighed after oven drying. Removal of pegs resulted in increasing the root biomass in all the six cultivars and haulm biomass only in Virginia and Spanish cultivars. Cultivars showed an increase in number of aerial pegs but a decline in immature and mature pods. The total number of fertilized flowers were considerably enhanced in Virginia cultivars whereas in Spanish and Valencia it was decreased. The yield was affected but the extent varied with cultivars. Virginia cultivars compensated better for initially lost pegs.

**Key words :** Peg removal; Yield components; Groundnut

## INTRODUCTION

Groundnut plants generally start flowering from the third week of sowing and continue for about 70 days depending on the genotype. Fluctuations in flowering within this period have been observed to occur in all three of the major groundnut cultivars- Valencia, Spanish and Virginia (Nicholaides *et al.*, 1969). The fluctuations result in flushes of flowering which are partly controlled by existing temperature, moisture and relative humidity (Bouffil, 1947; Smith 1954; Fortanier, 1957; Lee *et al* ., 1972). However, the early formed flowers in one flush may influence the late formed ones of another flush. Since the flowers formed early start producing the pods, the late formed flowers may get affected in pod production (Martin and Bilquez, 1962) probably for want of assimilates. If the early formed flowers or pegs are removed, the late ones may possibly produce the pods successfully.

In this experiment the pegs produced for a week after the onset of flowering were removed in order to study the plant's ability to compensate for the lost pegs as influenced by cultivars.

Received for publication on December 20, 1983

## MATERIALS AND METHODS

The experiment was conducted at the Agricultural College Farm, Hyderabad (17.33° N, 78.50 E) during the monsoon season (July) of 1978. Groundnut cultivars M 13, Robout 33-1 (Virginia), TG 16 (Spanish), TG 14, Gangapuri and GDM 1 (Valencia) were planted in randomized block design with four replications in alfisol after fertilizing the soil with 50 kg $P_2O_5$/ha. The plants were grown spacing 30 × 15 cm in 20 $m^2$ plot. The crop was protected from pests and diseases by spraying recommended pesticides and fungicides respectively.

Peg removal treatment involved the cutting of the young pegs developed from the leaf axils. The treatment was carried out in an area of 10 $m^2$ for one week from the day of the first peg appearance. In control plots the flowers were allowed to form pods continuously. The durations for maturity were 126 days for M 13 and TG 14, 114 days for TG 16 and Robout 33-1 and 87 days for Gangapuri and GDM 1.

At harvest, the dry weight of haulm, roots and pods; number of mature pods, aerial pegs and immature pods; kernel number per pod and 100-kernel weight were recorded and statistically analysed.

## RESULTS

### Effect on vegetative parts

The effects of peg removal on the dry weights of haulms and roots are shown in Fig. 1. There was about 10-16 per cent increase in biomass of haulms due to peg removal in M 13, Robout 33-1 and TG 16 whereas other three cultivars did not show the difference. On the other hand, removal of pegs caused an increase in root biomass significantly in all the cultivars. The increase was maximum in Robout 33-1 and minimum in M 13.

### Effect on reproductive parts

Removal of pegs considerably enhanced the number of immature pods of Robout 33-1, but it was reduced in other cultivars (Fig. 1). In M 13, the reduction was even to the extent of 51 per cent but it was only 7 and 4 per cent for TG 14 and GDM 1 respectively. The number of aerial pegs increased enormously (58 per cent) in M 13 due to peg removal. Although, the increase was also found in other cultivars, the extent was much low. It is interesting to note that M 13 had produced the maximum number of aerial pegs even in control compared with other cultivars and peg removal had still augmented its capacity to produce more number of pegs.

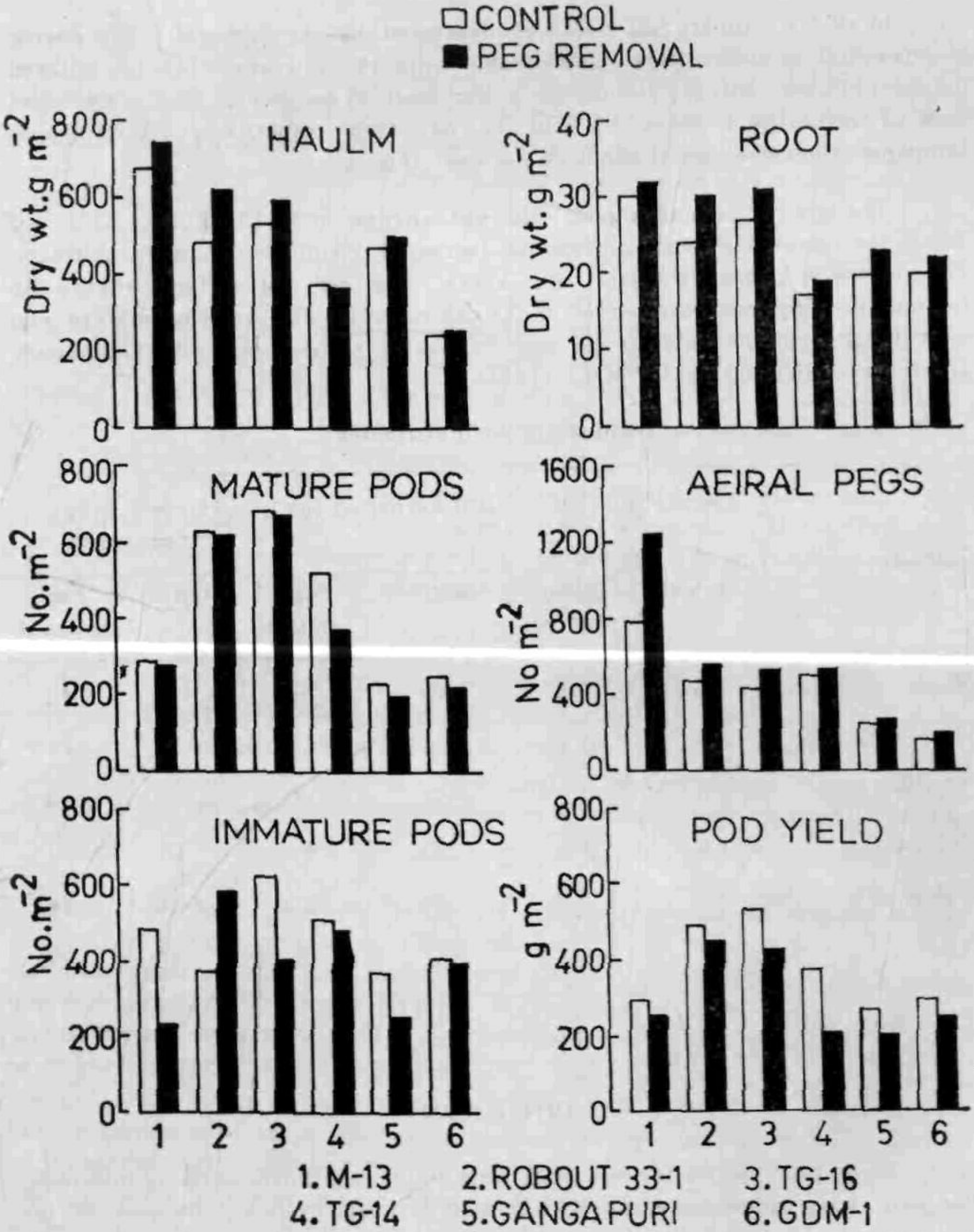


Fig. 1 : Response of plant parts and pod yield to peg removal in six groundnut cultivars (significant at P = 0.05)

**Effects on yield and yield components**

In all the cultivars pod yield was depressed by peg removal. The degree of depression in yield differed considerably with all cultivars. TG 14 suffered the most (46 per cent) and Robout 33-1 the least (8 per cent). The yield losses in M 13 and GDM 1 were 14 and 16 per cent respectively. TG 16 and Gangapuri showed a loss of about 26 per cent (Fig 1).

The number of mature pods did not change in M 13, Robout 33-1 and TG 16 but removal of pegs significantly decreased this number in other cultivars. The number of kernels per pod and kernel size did not differ between the treatments. However, the harvest index calculated on the basis of mature pod indicated a slight decrease for the peg removal treatment but for Gangapuri, and it was only marginal for M 13 (Table 1).

Table 1 : Effects of peg removal on yield attributes

| Cultivars | Kernels per pod | | 100-kernel wt.(g) | | Harvest index (per cent) | |
|---|---|---|---|---|---|---|
| | Control | Peg removal | Control | Peg removal | Control | Peg removal |
| M 13 | 1.6 | 1.5 | 64 | 66 | 17 | 14 |
| Robout 33-1 | 1.6 | 1.6 | 64 | 66 | 17 | 14 |
| TG 16 | 1.6 | 1.5 | 64 | 68 | 32 | 24 |
| TG 14 | 1.8 | 1.8 | 39 | 37 | 27 | 18 |
| Gangapuri | 2.1 | 2.2 | 39 | 35 | 16 | 16 |
| GDM 1 | 2.1 | 2.1 | 37 | 35 | 34 | 27 |
| LSD (P = 0.05) | 0.9 | | 15 | | — | |

## DISCUSSION

When pegs formed for one week were prevented from developing into pods, the plants were induced to grow more in roots and tops probably because of the assimilates being diverted to these plant parts for growth. It was also shown in pigeonpea that removal of flowers resulted in accumulation of large amounts of starch in stem (Sheldrake *et al*, 1979). Similarly, stem growth in groundnut was found to increase due to removal of half of the pods (Williams *et al*, 1976).

The increase in haulm biomass was not noticed in Valencia group but the root biomass was found to increase in every cultivar tested

Significant enhancement in number of aerial pegs was observed due to peg removal for Virginia and Spanish cultivars but it was marginal for others. Peg removal thus stimulated the plants to produce more and more flowers in order to compensate for the lost ones. Under certain conditions, cowpeas have been shown to compensate completely for the removal of flowers and young pods upto 9 days (Ojehomon, 1970).

In groundnuts, although more number of flowers are produced, their success to develop into pods is limited because of the time lag and the position they occupy in the plant. It may be possible that the increase in number of aerial pegs would have resulted in the fewer immature pods observed in all cultivars except in Robout 33-1 which produced higher number of immature pods. Although this cultivar belongs to Virginia, the duration was much shorter than M 13 (144 days vs 130 days). Therefore, at the time of harvest, most of the pods would not have been matured in the peg removal treatment. Shear and Miller (1955) also showed that the removal of pegs from the beginning of peg formation for one month in runner groundnuts did not reduce the number of large pods at harvest, although, later formed pods were less mature at harvest.

The number of mature pods was reduced significantly as a consequence of peg removal in Valencia cultivars which again suggests that these cultivars were not able to compensate for the initially lost pegs. The total numbers of aerial pegs, immature and mature pods must be produced from the total number of fertilized flowers. By computing the percentages from the total proportion of these reproductive structures as influenced by peg removal is seen from Table 2.

The number of fertilized flowers increased considerably in Virginia cultivar by removal of pegs. However, the percentage of aerial pegs produced from these flowers was 71 per cent for M 13 and 32 per cent for Robout 33-1 which may be due either to the differences in duration of these two cultivars as mentioned earlier or to the growth rates of the aerial pegs. Moreover, the pod and kernel sizes of M 13 were almost double that of Robout 33-1. Therefore, *the time required for converting the aerial pegs into mature pods may be more* for the former cultivars which is evident from the less proportion (13 per cent) of immature pods observed, in this cultivar. Thus it indicates that Virginia cultivars were able to compensate and produce more fertilized flowers as a result of peg removal which in fact had reduced the proportion of these flowers in the Spanish and Valencia cultivars except in GDM 1 because of its dwarf, determinate and short duration (75 days) characters. The number of kernels per pod and

Table 2 : Total number of fertilized flowers and its distribution

| Cultivars | Number per m² | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Aerial pegs | | Immature pods | | Mature pods | | Total | |
| | Control | Peg removal | Control | Peg removal | Control | Peg removal | Control | Peg removal |
| M 13 | 783 (50.8)* | 1241 (70.8) | 476 (30.7) | 234 (13.4) | 287 (18.5) | 277 (15.8) | 1550 | 1754 |
| Robout 33-1 | 469 (32.0) | 572 (32.2) | 368 (25.1) | 581 (32.7) | 627 (42.8) | 622 (35.0) | 1464 | 1775 |
| TG 16 | 432 (24.9) | 522 (32.7) | 619 (35.7) | 403 (25.2) | 683 (39.4) | 672 (42.1) | 1734 | 1597 |
| TG 14 | 599 (32.7) | 532 (38.5) | 509 (33.4) | 476 (34.4) | 517 (33.9) | 375 (27.1) | 1525 | 1383 |
| Gangapuri | 243 (28.8) | 266 (36.9) | 369 (43.8) | 252 (35 0) | 231 (27.4) | 202 (28.1) | 843 | 720 |
| GDM 1 | 160 (19.6) | 200 (24.6) | 409 (50.1) | 393 (48.3) | 247 (30.3) | 221 (27.1) | 816 | 814 |
| LSD (0.05) | | 65 | | 48 | | 12 | | — |

Data in parentheses are the per cent values over total

kernel size were not influenced by removal of pegs whereas the pod yield was affected. Again the loss was considerably less for Virginia cultivars and GDM 1. It appears, therefore, that removal of pegs in groundnut for one week stimulated root and haulm growth (only in Virginia and Spanish cultivars) probably as a result of diversion of assimilates and cultivars responded differently to production of flowers and formation of pods.

## LITERATURE CITED

BOUFFIL, F. 1947. Biologie, ecologie et selection de 1' arachide au Senegal. *Ministere de la France, d'Outre-Mer. Bulletin Scientifique* 1 : 1-121.

FORTANIER, E. J. 1957. De beinvloeding van bloei bij *Arachis hypogaea* L. *Modelingen van de LandLouwhogeschool te Wageningen, Nederland* 57 : 1-116.

LEE, Jr. T. A., KETRING, D. L. AND POWELL, R. D. 1972. Flowering and growth response of peanut plants *Arachis hypogaea* L. *Plant Physiol.* 49 : 190-193.

MARTIN, J. P. and BILQUEZ, A. F. 1962. Nouvelle contribution a la connaissance de la floraison et de la fructification de l' arachide. *Oleagineux* 17 : 469-471.

NICHOLAIDES, J. J., COX, F. R. and EMERY, D. A. 1969. Relation between environmental factors and flowering periodicity of Virginia type peanuts. *Oleagineux* 24 : 681-683.

SHEAR, G. M and MILLER, L. I. 1955. Factors affecting fruit development of the Jumbo runner peanut. *Agron. J.* 47 : 354-357.

SHELDRAKE, A. R., NARAYANAN, A. and VENKATARATNAM, N. 1979. The effects of flower removal on the seed yield of pigeonpeas *Cajanus cajan*. *Ann. Appl. Biol.* 91 : 382-390.

SMITH, B.W. 1954. *Arachis hypogaea*. Reproductive efficiency. *Amer. J. Bot.* 41 : 607-616.

WILLIAMS, J. H., WILSON, J. H. H. and BATE, G. C. 1975. The growth of groundnuts (*Arachis hypogaea* L.) cv Makulu Red at three altitudes in Rhodesia. *Rhod. J. Agric. Res.* 13 : 33-43.

J. Oilseeds Res. 1(1984) : 71-75

## Short Communications

# Oil content and fatty acids variation in mutants of *Brassica juncea* L. Czern & Coss

**K. L. Ahuja, K. S. Labana, R. K. Raheja and S. S. Badwal**
Department of Plant Breeding
Punjab Agricultural University, Ludhiana - 141 004

The quality of an oil depends upon its fatty acid composition. Mustard is valued for both high and low erucic acid. Information regarding varietal variation in the mustard is limited. In our previous communication (Labana *et al*, 1978), we had reported chemical constituents of 21 *Brassica juncea* mutants. In the present study, variation and correlation among fatty acids and oil content in the mutants and their parental type RL 18 have been reported.

Dry seeds of *B. juncea*, L 18 were treated with 50 kr, 100 kr, 150 kr and 200 kr of gamma rays using Co 60 source at the Indian Agricultural Research Institute, New Delhi during 1969. Mutants were selected from the advanced generations and analysed for oil and fatty acids. Oil content was estimated by NMR (Newport Analyser, Model MKIII A). For fatty acid analysis, oil was extracted by the method of Kartha and Sethi (1957). Fatty acid methyl esters were prepared by the method of Luddy *et al* (1968) and analysed by gas liquid chromatography as described earlier (Sekhon *et al*, 1972). Data were statistically analysed and the correlation coefficients were estimated.

The data on oil content and fatty acid composition (Table 1) showed the variation with respect to oil and fatty acid components among the mutants as well as in comparison to the parental type RL 18. Per cent oil content ranged from 37.6 (RLM 3) to 43.9 (RLM 96); while the fatty acids, palmitic varied from 1.8 (RLM 96) to 4.6 (RLM 3); oleic from 8.0 (RLM 29/25) to 17.2 (RLM 45); linoleic from 11.8 (RLM 45) to 23.1 (RLM 528); linolenic from 3.3 (RLM 602) to

Received for publication on November 3, 1983

Table 1. Oil content and fatty acid composition of *Brassica juncea* mutants

| Strain | Oil content | Acids % | | | | | |
|---|---|---|---|---|---|---|---|
| | | Pal-mitic | Oleic | Lino-leic | Lino-lenic | Eicose-noic | Erucic |
| RLM 240 | 40.3 | 2.1* | 14.8 | 20.4 | 6.9 | 8.8 | 47.0 |
| 29 | 40.1 | 2.7 | 15.6 | 19.9 | 6.8 | 7.6 | 47.4 |
| 105 | 40.3 | 2.5 | 13.1 | 19.6 | 8.3 | 7.0 | 49.4 |
| 528 | 41.8 | 2.9 | 15.1 | 23.1 | 7.7 | 8.3 | 42.8 |
| 83 | 43.3* | 3.5 | 14.5 | 17.4 | 7.8 | 9.7 | 47.2 |
| 198/1 | 41.6 | 2.9 | 9.7* | 20.3 | 10.0* | 6.5 | 50.6 |
| 84 | 41.3 | 2.1* | 10.6 | 18.0 | 9.6* | 5.8* | 53.5 |
| 78 | 39.5 | 2.0* | 13.2 | 18.5 | 7.3 | 6.1 | 52.9 |
| 215 | 43.4* | 2.1* | 12.4 | 18.2 | 6.1 | 6.1 | 55.2* |
| 183 | 39.9 | 2.6 | 12.9 | 20.6 | 7.4 | 7.6 | 49.0 |
| 85 | 40.7 | 2.8 | 13.3 | 16.0 | 7.7 | 11.2 | 49.1 |
| 29/25 | 38.8 | 3.6 | 8.0* | 20.8 | 8.4 | 10.2 | 49.0 |
| 3 | 37.6 | 4.6 | 15.5 | 20.1 | 6.6 | 9.2 | 44.0 |
| 602 | 41.7 | 3.1 | 15.2 | 16.2 | 3.3 | 6.6 | 55.6* |
| 171 | 42.0 | 3.7 | 14.9 | 13.6 | 4.6 | 8.0 | 55.3* |
| 45 | 40.0 | 4.5 | 17.2 | 11.8 | 3.5 | 12.6 | 50.4 |
| 546 | 37.4 | 2.7 | 14.4 | 19.0 | 3.3 | 7.3 | 53.4 |
| 82 | 40.8 | 3.1 | 14.4 | 20.2 | 4.3 | 6.1 | 52.1 |
| 96 | 43.9** | 1.8** | 14.9 | 21.1 | 5.6 | 8.2 | 48.5 |
| 514 | 42.2 | 4.3 | 16.7 | 19.7 | 5.8 | 10.7 | 42.9 |
| 1198 | 41.9 | 2.9 | 13.9 | 18.8 | 7.1 | 8.1 | 49.3 |
| Mean | 40.8 | 3.0 | 13.8 | 18.7 | 6.5 | 8.2 | 49.6 |
| RL 18 | 39.0 | 4.3 | 14.5 | 18.9 | 5.3 | 9.7 | 46.9 |
| *CD 5% | 3.6 | 1.8 | 4.5 | 5.3 | 4.0 | 3.9 | 7.9 |
| **CD 1% | 4.9 | 2.4 | 6.2 | 7.3 | 5.4 | 5.3 | 22.4 |

10.0 (RLM 198/1); eicosenoic from 5.8 (RLM 84) to 12.6 (RLM 45) and erucic content from 42.8 (RLM 528) to 55.6 (RLM 602).

Mutants RLM 83, RLM 215, RLM 96 showed significantly higher oil content than the parent. Mutants RLM 45 and RLM 514 had higher oleic acid but the increase was not significant. However, two mutants (RLM 198/1 and RLM 84) recorded significantly higher percentage of linolenic acid than RL 18. Three mutants namely, RLM 514, RLM 528 and RLM 3 showed low content of erucic acid. The earlier finding (Labana *et al.* 1978) of RLM 514 and RLM 528 having low erucic acid has further been confirmed in the current investigation. From the nutritional point of view, these three mutants are better because of low erucic acid content and slightly higher concentration of oleic and linoleic acids. On the other hand three mutants (RLM 215, RLM 171, RLM 602) showed a significant increase in erucic acid content over RL 18.

Correlation coefficients among oil and its fatty acids are presented in Table 2. Oil content was found to have no correlation with any of the fatty acids. This finding was in agreement with the earlier studies in *B. campestris* (Ahuja *et al*, 1975). However, Klassen (1976) showed that there was a significant positive correlation between erucic acid level and oil content in different populations of rape (*B. campestris*). He also reported that strains with 20% erucic acid content would possess 1 to 3% more oil content than strains with no erucic acid but this was not found to be true in the present studies.

Table 2 : Correlation coefficients among oil and fatty acid components

| Name | Palmitic | Oleic | Linoleic | Linolenic | Eicosenoic | Erucic |
|---|---|---|---|---|---|---|
| Oil | —0.170 | 0.080 | —0.338 | 0.101 | 0.096 | 0.170 |
| Palmitic | | 0.422* | 0.083 | —0.334 | 0.657* | —0.493* |
| Oleic | | | 0.048 | —0.574** | 0.324 | —0.463* |
| Linoleic | | | | 0.337 | 0.034 | —0.729** |
| Linolenic | | | | | 0.256 | 0.435* |
| Eicosenoic | | | | | | 0.030 |

* Significant at P = 0.05

** Significant at P = 0.01

Among the fatty acids, palmitic acid had a significant positive association with oleic and eicosenoic acids but showed a negative correlation with erucic acid. Oleic acid had significant negative correlation with linoleic acid and erucic acids. A reciprocal correlation between linoleic acid and erucic acid was also found to exist. On the other hand linolenic acid had a positive correlation with erucic acid. Gross and Stafansson (1966) reported significantly negative correlation between erucic acid and linolenic acid while Craig and Watter (1959) observed significantly negative correlation between oleic and erucic acid. In Taiwan rapeseed, Chen *et al* (1977) reported a highly significant negative correlation between erucic and palmatic acid (-0.5778) erucic and oleic acid (-0.9665), and erucic and linoleic acid (-0.7649).

Negative correlation of palmitic, oleic and lenoleic acids with erucic acid is of great significance in breeding varieties having high erucic acid which is a desirable character for the manufacture of certain chemicals (Bruun and Matchett, 1963). On the other hand, the negative correlations would also be helpful in obtaining varieties with very low erucic acid content which would improve the nutritional quality of the oil (Downey, 1966).

## LITERATURE CITED

AHUJA, K. L., SEKHON, K. S. AND SINGH, T. 1975. Correlation studies in oil and fatty acids of Toria (*Brassica campestris*). *Indian J. Agric. Res.* 9 : 140-144.

BRUUN, J. H. and MATCHETT, J. R. 1963. Utilization potential of *Crambe abyssinica*. *J. Am. Oil Chem. Soc.* 40 : 1-5.

CHEN, C., HUANG, Y. C. and LU HUNG, S. 1977. Inheritance of the erucic acid in rapeseed. *K'O Hsuch Fa Chan Yuen K'an.* 5 : 1029-34 (cited from C. A. 92 : 137507).

CRAIG, B. M. and WATTER, L. R. 1959. Varietal and environmental effects on rapeseed. II. fatty acid composition of the oil. *Can. J. Pl. Sci.* 39 : 437-442.

DOWNEY, R. K. 1966. Breeding for fatty acid composition in Oil of *Brassica napus* L. and *B. campestris* L. *Qual. Plant Material Vegetables* 13 : 171-180.

GROSS, A. T. H. and STAFANSSON, B. R. 1966. Effect of planting date on protein, oil and fatty acid content on rapeseed and Truimp rape. *Can. J. Pl. Sci.* 46 : 389-395.

KARTHA, A. R. S. and SETHI, A. S. 1957. A cold percolation method for rapid gravimetric estimation of oil in small quantities of oilseeds. *Indian J. Agric. Sci.* 27 : 211-217.

KLASSEN, A. J. 1976. Relationship between quality and quantity of oil in *Brassica* species, *Can. J. Plant Sci.* 56 : 427.

LABANA, K. S., BADWAL, S. S. and AHUJA, K. L. 1978. Variability and inter-relationship among quality traits in *Brassica juncea* mutants. 5th International rapeseed conference held at Malmo, Sweden 12th to 6th June 1978 B : 13.

LUDDY, F. E., BARFORD, R. A., HERB, S. F. and PAUL, M. J. 1968. A rapid and quantitative procedure for the production of methyl esters of butter oil and other fats. *J. Am. Oil Chem. Soc.* 45 : 549-552.

SEKHON, K. S., AHUJA, K. L. SANDHU, R. S, and BHATIA, I. S. 1972. Variation in fatty acid composition on peanut. I. Bunch group. *J. Sci. Fd. Agri.* 23 : 919-922.

J. Oilseeds Res. 1(1984) : 77-79

# Effect of date of sowing on the incidence of *Dasineura lini* Barnes (Diptera : Cecidomyidae) and yield of linseed

**Y. K. Mathur, Basant Singh, Ram Anjor and J. P. Srivastava**
Department of Entomology, C. S. Azad University of
Agriculture & Technology, Kanpur, U. P.

Linseed (*Linum usitatissimum* Linn.) is an important oil seed crop in the rainfed areas of Uttar Pradesh, particularly, Bundelkhand region. The extensive and intensive survey conducted in the linseed growing tracts of this state reveal that this crop suffers heavy losses from the ravages of a variety of pests viz. *Diacrisia obliqus* Wlk; *Plusia* spp; *Phytomyza horticola* Gour; *Dasineura lini* Barnes; *Bemisia tabaci* Genn. and *Amrasca* spp. Among these insect pests, linseed bud fly (*D. lini*) is a limiting factor in the high productivity of this crop.

Keeping in view the seriousness of linseed bud fly and harmful effects of insecticides, it was felt desirable to control this pest by cultural practices involving different dates of sowing so that the crop may escape the damage caused by pest. Pal *et al* (1978) demonstrated that the minimum incidence of this past and maximum yield of linseed were obtained when the crop was sown early. However, they did not mention the effect of October sowing which appears to be an ideal time of sowing for linseed in this state to avoid bud fly incidence. Therefore, the present studies were undertaken to record the observations on the incidence of *D. lini* and yield of linseed when sown at different intervals from October to November.

The experiment was laid out during Rabi 1977-78 at Chandra Shekhar Azad University of Agriculture & Technology, Kanpur in a randomized block design with three replications. The size of plot was 4 m × 3m and distance from row to row and plant to plant as 25 cm and 8cm respectively. The different dates of sowing of Neelum veriety were adjusted within 2nd week of October to first fortnight of November as shown in Table 1. Observations were recorded on the percentage of pods damaged and the yield of crop. The data thus obtained were subjected to analysis of variance.

Received for publication on November 28, 1983

Table 1: Effect of different dates of sowing on the occurrance of linseed bud fly and yield of linseed crop

| Date of sowing | Percentage of pods infested by gall midge | | Yield per plot in (kg) | Yield per ha (qts) |
|---|---|---|---|---|
| | Actual value | Angular value | | |
| 11-10-77 | 38.60 | 38.41 | 1.090 | 9.92 |
| 18-10-77 | 39.57 | 38.98 | 1.387 | 11.56 |
| 25-10-77 | 38.36 | 38 27 | 0 995 | 8.29 |
| 1-11-77 | 57.77 | 49.47 | 0.625 | 5.21 |
| 8-11-77 | 71.37 | 57.65 | 0.672 | 5.60 |
| 15-11-77 | 76.91 | 61.28 | 0.607 | 5.05 |
| S. E. m. ± | | 1.88 | 0.114 | |
| C. D. at 5% | | 4.02 | 0.240 | |

It is evident from Table 1 that the different dates of seeding have marked influence on the incidence of linseed bud fly and the yield of crop. As regards infestation of gall midge in terms of percentage pods damaged, it was minimum when the crop was sown in the month of October and there after the intensity of damage increased significantly. It was as high as 76.91 per cent in the crop sown on 15th November, 1977. The present finding is in conformity with the observations made at Tikamgarh centre (Anon., 1983) of Madhya Pradesh where it has been reported that linseed sown in the month of October receives the minimum infestation of *D. lini*.

Considering the impact of sowing date variations on the yield of linseed it was found that maximum yield (1.387 kg/plot) is obtained with the sowing of crop on 18th October, 1977. Of course, there is no significant difference in yield when compared with other early date of sowing i.e. 11th October, 1977. The seeding of crop in the month of November resulted in significantly poor yields. The lowest yield (0.607 kg/plot) was recorded when the crop was sown on 15th November, 1977. Similar observations have also been recorded at Tikamgarh centre (Anon., 1983).

From the foregoing discussion, it is obvious that crop sown by middle of October had the minimum incidence of gall midge and maximum yield of linseed crop.

The authors are grateful to Vice-chancellor, Chandra Shekhar Azad University of Agriculture and Technology, Kanpur for providing necessary facilities during the course of investigation. Help rendered by Sri D. C. Kaushik in statistical analysis is also gratefully acknowledged here.

## LITERATURE CITED

ANONYMOUS 1983. Effect of different dates of sowing on the incidence of linseed bud-fly (*Dasineura lini* Barnes). Linseed annual progress report. All India Co-ordinated Research Project, 1982-83: 113-114.

PAL, L. SRIVASTAVA, J. L. and PANDEY, N. D. 1978. Effect of different dates of sowing on the incidence of *Dasineura lini* Barnes (Diptata : Cecidomyiidae). *India J. Ent.* 40 (4) : 433-434.

J. Oilseeds Res. 1(1984) : 81-82

# Screening of some *Brassica* species and their strains for resistance to mustard aphid

D. R. C. Bakhetia, K. S. Brar and B. S. Sekhon
Department of Plant Breeding,
Punjab Agricultural University, Ludhiana-141 004

Among the various pests of *Brassica* crops, the mustard aphid, *Lipaphis erysimi* (Kalt.) is the most destructive and causes about 24 per cent yield loss in India (Bakhetia, 1983). The use of resistant varieties serves as an effective, safe economical method to save the crop from ravages of the pest. The present studies were undertaken to evaluate the available germplasm to identify the potential lines for use in developing aphid resistant cultivars.

A total of 286 entries consisting of *B. juncea* (267), *B. campestris* (9), *B. napus* (7), *B. alba* (1), *B. carinata* (1) and *B. tournefortii* (1) were tested in six trials at Ludhiana (1976-77 to 1981-82) and two at Faridkot (1980-81 to 1981-82) in randomized block design with three replications, keeping single row of 5m length for each variety. Row to row and plant to plant distance were maintained as 45 and 60 cm respectively. Population of the aphids per plant was recorded every season twice, at full bloom and pod formation stages, in randomly selected five shoots (one shoot per plant) in each replication.

The population of the aphid at Ludhiana remained very low during 1967-77 and moderate during 1977-78, 1978-79 and 1981-82. It was very high during 1979-80 at Ludhiana and 1981-82 at Faridkot, whereas during 1980-81 the pest population was high at both the places.

Ten cultivars/varieties viz. P 26/21, RCU 10, RH 7326, RK 2, RLM 84, RLM 185, RLM 198. RLM 528, RW 85-59 of *B. juncea* and a strain of *B. tournefertii* were observed to be fairly resistant to mustard aphid as these harboured lower aphid population invariably in every year of testing (Table 1). Highly susceptible cultivars/varieties were Pant Rai 1002, RH 763, RH 781, RH 7361, RIK 3, RK 12, RL 18, RLM 188, RLM 240 and RLM 549.

---

Received for publication on December 2, 1983

Table 1 : Population of the mustard aphid on the promising lines during different years under testing

| | Cultivars | Average number of aphids per shoot/plant* | | | | | |
|---|---|---|---|---|---|---|---|
| | | 1976-77 | 1977-78 | 1978-79 | 1979-80 | 1980-81 | 1981-82 |
| 1. | P 26/21 | — | 32 | 14 | 177 | — | 76<br>22* |
| 2. | RCU 10 | — | 36 | — | — | — | 76<br>25* |
| 3. | RH 7326 | — | 14 | 29 | 141 | — | — |
| 4. | RK 2 | — | — | 10 | — | — | 83<br>30* |
| 5. | RLM 84 | 25 | 14 | 45 | 97 | 154 | 75<br>34* |
| 6. | RLM 185 | — | — | 58 | 84 | 145 | 80<br>23* |
| 7. | RLM 198 | 22 | 36 | 17 | 97 | 30* | 60<br>79* |
| 8. | RLM 528 | 12 | — | 40 | 120 | 150 | 71<br>9* |
| 9. | RLM 85-59 | — | — | — | — | 148 | 76<br>43* |
| 10. | *B. tournefortii* | — | — | — | 88 | — | 67<br>1* |

* Average of 3 replications, each comprising 5 plants; All the trials were conducted at Ludhiana, except those marked as *, which were conducted at Faridkot.

Promising resistant lines thus observed can be used in the breeding programme aimed at developing high yielding varieties possessing resistance to the mustard aphid.

The authors are grateful to Dr. K. S. Labana, Senior Oilseeds Breeder, Department of Plant Breeding, PAU, Ludhiana, for his interest in this work and for providing necessary facilities.

## LITERATURE CITED

BAKHETIA, D. R. C. 1983. Losses in rapeseed/mustard due to *Lipaphis erysimi* (Kaltenbach) in India : a literature study. Proc. *6th Intern. Rapeseed Conf.* Paris, May 19-20, 1983.

J. Oilseeds Res. 1(1984) : 83-84

# Occurrence of *Alternaria alternata* (Kissler) on safflower and sesamum from India

**A. L. Siddaramaiah and R. K. Hegde**
Department of Plant Pathology,
College of Agriculture, Dharwad-580 005, India

Safflower (*Carthamus tinctorius* L.) and sesamum (*Sesamum indicum* DC.) are the two important oilseed crops in Karnataka and commonly grown under rainfed conditions during Rabi (October-November) and early Kharif (June-July) respectively. Leaf blight of safflower caused by *Alternaria carthami* (Chowdhury and Beraha) and *A. sesami* (Kaw) on sesamum has been reported earlier by several workers (Chowdhury, 1964 ; Rao, 1964). Since last three years, authors observed the association of *Alternaria alternata* (Kissler) on the Alternaria leaf blight of safflower and sesamum under field conditions. This fungus was dominating over other *Alternaria* spp. on safflower and sesamum during September-October and July-August, respectively.

Repeated isolations from the infected leaves of safflower and sesamum yielded *Alternaria crathami* plus *A. alternaria* and *A. sesami* plus *A. alternata*, respectively. All the three fungi were purified by single spore isolation technique. Koch's postulates were confirmed separately on respective hosts. Further, the mixture of *A. carthami* and *A. alternata* as well as *A. sesami* and *A. alternata* were also inoculated on safflower and sesamum respectively, and the characteristic symptoms of the disease on inoculated leaves of safflower and sesamum were produced. When *A. alternata* alone was inoculated on safflower and sesamum, the early visible symptoms on the inoculated leaves were in the form of water soaked spots. These spots later turned to brown on the hosts. Further, the spots are surrounded by a yellow halo on both the hosts.

*Alternaria alternata* was grown on potato dextrose broth for 20 days and filtered through filter paper. The filtrate was centrifuged at 3000 rpm. and the supernatant was tested for its phytotoxicity on datached leaves of safflower and sesamum. On both the hosts, necrotic flecks appeared after 16 hours of incubation under moist chamber.

---

Received for publication on December 12, 1983

All the three species of *Alternaria* were identified on the basis of conidial measurement and morphology and identifications were confirmed by C. M. I. London (IMI No. 233775: *A. sesami*; IMI 233776: *A. carthami* and IMI 233777: *A. alternata*). Persual of the literature suggests that *A. alternata* is a new record on safflower and sesamum and causing leaf spot in India. Combined effect of *A. alternata* with *A. crathami* and *A. sesami* resulted in severe leaf blight on the the safflower and sesamum, respectively.

Authors are grateful to the Director, Commonwealth Mycological Institute, Kew, England for confirming the identification of the pathogens.

## LITERATURE CITED

COWDHURY, S 1946. An *Alternaria* disease of safflower. *J. Indian Bot. Sci.* Sci. 23 : 59-65.

RAO, V. G. 1964. The genus *Alternaria* in Bombay, Maharashtra. *J. Cydowidia* 18 : 46-64.

J. Oilseeds Res. 1(1984) : 85-87

# Intensed dark green small leaf mutant in groundnut

**G. R. Bhole, S. S. Patil, and A. B. Deokar**
Agricultural Research Station, Jalgaon-425 001, India

The bunch variety JL 24 ( Phule Pragati ) of groundnut *( Arachis hypogaea* L.*)* released in the year 1979 (Patil *et al* 1981) was grown at Jalgaon, during summer 1980. A new bunch genotype was detected in this variety. The mutant is having medium plant type, small dark green leaflets profuse secondary branches, early maturity by five to seven days as compared to Phule Pragati (Figure 1). The distinguishing characters of JL 24 and the mutant (JL 50) are given in Table 1.

Table 1 : Distinguishing morphological characters of JL 24 and JL 50 (mutant).

| Character | JL 24 | Mutant (JL 50) |
|---|---|---|
| 1. Growth habit | Bunch | Bunch |
| 2. Plant height (cm) | 40-45 | 30-35 |
| 3. Branching (number) | Primary (7.00)<br>Secondaries (0.66) | Primary (8-00)<br>Secondaries (1.89) |
| 4. Leaf | | |
| i) Foliage colour | Dark green | Intensed dark green |
| ii) Leaflet size (Length x Breadth cm) | Medium to big<br>(7.6 x 3.9) | Smaller to medium<br>(6.5 x 2.6) |
| 5. Flowering span (days) | 22-26 | 22-26 |
| 6. Days to first flower | 24 | 22 |
| 7. Pod characters | | |
| i) Size | Medium | Medium |
| ii) Reticulation | Smooth | Smooth |
| iii) Constriction | Shallow | Shallow |
| iv) Kernel nature : | One seeded 1.22<br>Two seeded 15.42<br>Three seeded 0.99 | 1.94<br>15.14<br>0.71 |
| v) Beak | Prominent | Not so **prominent** |
| vi) Shelling (%) | 75 | 75 |

Received for publication on December 27, 1983

| | Character | JL 24 | Mutant (JL 50) |
|---|---|---|---|
| 8. | Kernel characters | | |
| | i) Size | Medium | Medium |
| | ii) Colour | Rose | Rose |
| | iii) 100 kernel wt. (g) | 42-56 | 40-42 |
| 9. | Oil content (%) | 50.7 | 50.5 |
| 10. | Days to maturity | 85-90 | 80-85 |
| 11. | Pod yield q/ha | 16-20 | 15-16 |

Average of 10 plants


Fig. 1 : Comparative plant type of JL 50 (mutant) and JL 24

The mutant was tested for its true breeding nature and subsequently seed was multiplied. The yield potential of the mutant was tested for two Kharif seasons (1982 and 1983) in a simple comparative trial (replicated seven times) alongwith JL 24 and S.B. XI at the Agricultural Research Station, Jalgaon. The results revealed that this mutant has showed significantly higher yield than SB XI and was at par to JL 24 in both the seasons (Table 2).

Table 2 : Dry pod yield of JL 24, S.B. XI and the mutant in the trials at Jalgaon

| Variety | Pod yield (kg/ha) | |
|---|---|---|
| | 1982 | 1983 |
| JL 24 | 1421 | 1870 |
| Mutant (JL 50) | 1361 | 1820 |
| S.B. XI | 831 | 567 |
| S.E. ± | 61 | 18.50 |
| C. D. (5%) | 183 | 56.83 |

This mutant was observed to be tolerent to leaf miner (*Aproaerema modicella* D.) and is being used in further breeding programme at Jalgaon.

## LITERATURE CITED

Patil, G. D., Desale, S. C., Patil, P. S. and Patil, S. S. 1980. Phule Pragati-A high yielding early bunch groundnut for Maharashtra. *J. Maharashtra Agric. Univ.* 5 (1) : 47-52.

*J. Oilseeds Res.* 1(1984) : 89-90

# Inheritance of ray floret shape in sunflower

**Shantha R. Hiremath and K. Giriraj**
University of Agricultural Sciences, Bangalore-560 065

In sunflower *(Helianthus annuus* L.*)* the ray florets which play an important role in attracting bees and other insects are flat and possess bright yellow to orange colour. A variant of this usual form was observed in one of the germplasm lines which had tubular ray floret wherein the edges of ray floret had fused forming a tubular structure. The present study reports the inheritance of this character.

Three inbred lines were used in the crossing programme. Morden (Cernianka 66) is an introduced variety from Canada now under cultivation in India. It has flat ray florets. Tubular inbred is a natural mutant found in 3-CR-37 line maintained in AICORPO, Sunflower Scheme. As the name indicates the inbred has fused or tubular ray florets. Another inbred line EC. 85821 has pigmented plant parts with flat ray florets. The hybrid seeds from two crosses, viz. Morden x Tubular inbred and Tubular inbred x EC 85821 were obtained in the Kharif (rainy) season of 1980. The $F_1$ generation of both the crosses were raised in the Summer season of 1981 to obtain $F_2$ seeds. In both the crosses, the $F_1$ generation exhibited flat ray floret after flowering thus indicating its dominance over tubular nature. During Kharif seasan of 1981, $F_2$ generation was raised. Morden x Tubular inbred cross had $F_2$ population of 123 plants of which 98 plants had flat ray floret and 25 plants had tubular ray floret which approximated ratio of 3 flat : 1 tubular (Table 1).

Table I : Nature of segregation for ray floret shape in $F_2$

| Cross | | Number of plants with ray floret shape | | Ratio | $X^2$ | 'P' Value between |
|---|---|---|---|---|---|---|
| | | Flat | Tubular | | | |
| Morden x Tubular inbred | Obs. | 98.00 | 25.00 | 3 : 1 | 1.4336 | 0.50-0.10 |
| | Exp. | 92.25 | 30.75 | | | |
| Tubular inbred x EC 85821 | Obs. | 332.00 | 93.00 | 3 : 1 | 2.2000 | 0.50-0.10 |
| | Exp. | 318.00 | 106.25 | | | |

Received for publication on January 28, 1984

In another cross (Tubular inbred x EC 85821), segregation in the $F_2$ population (423 plants) consisted of 332 flat ray florets and 93 tubular ray florets, indicating the simple recessive nature of gene controlling tubular (fused) ray floret in sunflower. The ratio was subsequently confirmed in 30 $F_3$ families.

In both the crosses, segregation was observed in 3 flat : 1 tubular ratio. Hence, it can be concluded that ray floret shape in sunflower is monogenically controlled and flat ray floret is dominant over tubular nature which confirms the previous report of Fick (1976). Based on the present study, the gene symbol may be designated as '$F_1$' for flat ray floret.

This work was done under "Super Elite and Elite Sunflower Seed Production Scheme" sponsored by the Indian Council of Agricultural Research, New Delhi.

## LITERATURE CITED

FICK, G. N., 1976. Genetics of floral color and morphology in sunflowers. *The Journal of Heredity* 67 : 227-230.

J. Oilseeds Res. 1(1984) : 91-94

# Field evaluation of some improved lines of safflower to leaf blight caused by *Alternaria carthami* at Varanasi

**S. Roy and K. C. Basuchaudhary**
Department of Mycology & Plant Pathology,
Banaras Hindu University, Varanasi-221 005, India

Safflower (*Carthamus tinctorius* Linn) is an important oilseed crop sown during Rabi season (October-November) primarily as a rainfed crop. An area of 717 thousand hectares with annual production of 216 thousand tonnes has been estimated under this crop in India (Indian Agriculture in brief 1980, 18th edition). Many fungal, bacterial and viral disorders have been reported on this crop (Bilgrami *et al* 1979). Leaf blight caused by *Alternaria carthami* Choudhury, *A. zinniae* Pape and *A. tenuis* Auct. have been reported on safflower plants (Chowdhury, 1944; Rao, 1963, 1964). Important lines of safflower grown under "All India Co-ordinated Research Project on Oil Seeds" at B. H. U, farm exhibited severe blight symptoms on the foliage. Investigations revealed that causal organism inciting the blight is *Alternaria carthami* Choudhury. Studies were undertaken to assess the extent of disease severity (at periodical intervals) and its effect on yield.

Per cent disease incidence of 18 cultivars/lines was recorded 16 days before flowering and disease severity at the time of seed setting. Foliage disease intensity was estimated by collecting 100 leaves from each cultivar at random and was calculated using the formula suggested by Horsfall and Henberger (1942) modified to suit the crop. The blighted leaves were categorised as follows :

| Grade | Category value | Description |
|---|---|---|
| 1 | 0 | Healthy green leaves |
| 2 | 1 | 1-10 spots scattered, coalescing, leaf yellowing pronounced. |

Received for publication on February 4, 1984

| Grade | Category value | Description |
|---|---|---|
| 3 | 2 | 1-10 spots scattered, coalescing, covering 25-50% area of toe lamina. |
| 4 | 3 | 11-20 spots, scattered, coalescing on entire leaf surface, leaf yellowing, and marginal drying, spots occasionally distorted. |
| 5 | 4 | Leaf spots more than 20, coalescing, total yellowing of the leaf and drying. |

**Foliar Disease Index**

$$\text{FDI } (\%) = \frac{\text{Sum of the category values}}{\text{No. of leaves examined}} \times \frac{100}{4}$$

Yield data recorded at the time of harvest were correlated with the disease severity and the co-efficient of correlation was calculated using the formula given by Gupta and Saini (1980).

Per cent disease incidence, Foliar Disease Index (FDI) and yield per plot of safflower, cultivars/lines have been presented in Table 1. The data reveal that all the lines were susceptible to Alternaria blight disease and the lines differ in their relative susceptibility. More number of plants were infected with age. In case of per cent disease incidence HUS 305, HUS 304 and BLY 1020 were highly distinctive in terms of ranking compared to JSS 77A, JL-7-8. FDI of HUS 304 and HUS 305 were substantially lesser.

Disease incidence and yield parameters which are negatively correlated resulting in substantial reduction in yield of some susceptible varieties during present studies, agree with the findings of Zimmer (1963) and Irwin (1976). HUS 306 was found to be the highest yielder with less disease incidence.

Authors are grateful to Prof. R. M. Singh, Head and Dr. H. Kumar, Breeder (Safflower) for allowing to record the data from their trials (Department of Genetics and Plant Breeding, I. A. S., B. H. U.).

Table 1 : Reaction of the varieties against Alternaria blight

| S. No. | Cultivars/lines | A<br>Per cent disease incidence | B<br>Foliar disease index | Yield/Plot |
|---|---|---|---|---|
| 1 | HUS 304 | 0.8 | 43.9 | 1.84 |
| 2 | 1-55-22 | 16.8 | 62.9 | 1.82 |
| 3 | HUS 305 | 0.4 | 51.6 | 2.51 |
| 4 | T 65 | 68.0 | 50.7 | 1.05 |
| 5 | BLY 1022 | 65.6 | 60.1 | 1.74 |
| 6 | BLY 1035 | 25.2 | 71.3 | 1.42 |
| 7 | BLY 1020 | 15.2 | 58.0 | 1.74 |
| 8 | A 1 | 96.6 | 50.7 | 0.79 |
| 9 | NRS 209 | 89.2 | 50.6 | 1.25 |
| 10 | MYT 20 | 74.0 | 51.2 | 1.02 |
| 11 | BS 365 | 37.6 | 48.3 | 0.56 |
| 12 | 19-185 | 71.6 | 46.7 | 1.27 |
| 13 | JSF 3 | 47.6 | 45.2 | 0.88 |
| 14 | NS 10 | 54.8 | 42.1 | 0.53 |
| 15 | JL 7-8 | 77.2 | 48.1 | 1.02 |
| 16 | JSS 77A | 100.0 | 48.7 | 0.68 |
| 17 | MYT 28 | 41.0 | 58.7 | 1.07 |
| 18 | 19-51 | 98.8 | 58.1 | 1.01 |

Co-efficient of correlation (rxy) = -0.786

A. Data recorded from 11-1-83 to 12-1-83 (Mean of 250 plants)

B. Data recorded from 12-3-83 to 14-3-83 (Mean of 100 leaves)

## LITERATURE CITED

BILGRAMI, K. S., JAMALUDDIN AND RIZWI, M. A. 1979. **Fungi of India.** Part I. Today and Tomorrow, New Delhi. pp. 467.

CHAUDHURY, S. 1944. An Alternaria disease of safflower. *J. Ind. Bot. Soc.* 23: 59 65.

IRWIN, J. A. G. 1975. *Alternaria carthami* on safflower. *Aust. Pl. Path. Soc. Newsletter* 3: 24.

GUPTA, J. P. AND SAINI, S. 1980. Introduction to statistical methods. Kalyani Publishers, New Delhi-Ludhiana. p. 97.

HORSFALL, J. G. AND HENBERGER, J. W. 1942. Measuring magnitude of defoliation disease in tomatoes. *Phytopathology* 32: 226-232.

RAO, V. G. 1963. Some new host records of *Alternaria* sp. from India. *Mycopath. et. Mycol. Appl.* 19: 181-183.

RAO, V. G. 1964. Genus *Alternaria* Nees in Bombay. *Sydowia* 18: 46-64.

ZIMMER, D. E., KLISIEWICZ, J. M. AND THOMAS, G. A. 1963. Alternaria leaf spot and other diseases of safflower. *Pl. Dis. Reptr.* 49: 643.

J. Oilseeds Res. 1(1984) : 95-97

# Inheritance of leaf mutants in brown mustard

D. S. RAWAT and I. J. ANAND
Division of Genetics,
Indian Agricultural Research Institute, New Delhi-110 012, India

The occurrence of spontaneous mutants in *Brassica* has often been reported (Singh, 1961; Asthana and Singh, 1964) from time to time. In the present study, two spontaneous leaf mutants, designated as crimpled and chlorotic were observed by the authors in their breeding material during the crop seasons of 1977-78 and 1979-80 respectively. In the former, the plant bore excessively divided frilled leaves with crimpled lamina, while in the second, the leaves had creamish white patches of irregular shapes due to deficiency of chlorophyll. The chlorotic mutant was also characterised by light green to creamish white stem and creamish white small flowers. The young chlorotic leaves had the tendency to turn normal green in the later phase of the plant life.

Both these mutants were crossed with their normal counterpart to study the genetic behaviour involved in the inheritance of these characters. The crimpled leaf mutant was crossed reciprocally with the normal leaf variety, 'Varuna' while the chlorotic was crossed with three normal varieties namely Pusa Bold, Varuna and RLM 198. The $F_1$, $F_2$, $F_3$ and test cross generations were planted during the crop season from 1980-83.

All the plants of various generations were observed for the two mutant characters and $x^2$ test was applied to determine the goodness of fit to the observed ratios.

### Inheritance of crimpled mutant

All the plants in $F_1$ and reciprocal $F_1$ crosses of normal x crimpled leaf were normal, thereby indicating the dominance of normal leaf over crimpled. The distribution of $F_2$ data (Table 1) clearly revealed a digenic mode of inheritance for this trait with plant population segregating into 1278 normal and 75 crimpled leaf types. The observed $F_2$ ratio of 15 : 1 indicated a pair of duplicate factors controlling this character which was further supported by the $F_3$ progeny data. Among the 10 $F_3$ normal leaf progenies studied, six bred normal true, two segregated into 15 normal : 1 crimpled and two into 3 normal : 1 crimpled. The

Received for publication on March 10, 1984

Table 1 : Mode of inheritance of crimpled mutant

| Cross | Generation | Normal | Crimpled | Ratio | $x^2$ value | P value | Possible genotypes |
|---|---|---|---|---|---|---|---|
| Normal × Crimpled | $F_1$ | 32 | — | — | — | — | |
| Crimpled × Normal | $F_1$ | 26 | — | — | — | — | |
| | $F_2$ | 1274 | 79 | 15:1 | 0.3899 | 0.50-0.75 | |
| | $BC_2$ | 28 | 8 | 3:1 | 0.1481 | 0.50-0.75 | |
| Progenies in $F_3$ | | | | | | | |
| a) from 10 normal $F_2$'s | | | | | | | |
| 6 progenies | $F_3$ | All | — | — | | | $Cr_1$ $Cr_1$ $Cr_2$ $Cr_2$; $Cr_1$ $Cr_1$ $Cr_2$ $cr_2$ $cr_1$ $cr_1$ $Cr_2$ $Cr_2$; $Cr_1$ $Cr_1$ $cr_2$ $cr_2$ $cr_1$ $cr_1$ $Cr_2$ $Cr_2$ |
| 2 progenies | $F_3$ | 80* | 4 | 15:1 | 0.3174 | 0.50-0.75 | $Cr_1 cr_1$ $Cr_2$ $cr_2$ |
| 2 progenies | $F_3$ | 62* | 17 | 3:1 | 0.5105 | 0.25-0.50 | $Cr_1$ $cr_1$ $cr_2$ $cr_2$; $cr_1$ $cr_1$ $Cr_2$ $cr_2$ |
| b) from 2 | | | | | | | |
| crimpled $F_2$'s | $F_3$ | — | All | — | — | — | $cr_1$ $cr_1$ $cr_2$ $cr_2$ |

* Total over two progenies

progeny of two $F_2$ crimpled leaf plants also bred true in $F_3$ generation. The test cross ratio of 3 normal : 1 crimpled further confirmed the duplicate factor hypothesis.

The gene symbols assigned to the two factors of normal leaf are $Cr_1 Cr_1$ and $Cr_2 Cr_2$. The presence af both or any of the factors $Cr_1$ or $Cr_2$ either doubly or singly resulted in the development of normal leaves, while their absence in the double recessive genotype resulted in crimpled leaves. Based on the hypothesis, the gene symbols for the various progenies of the cross are indicated in Table 1.

**Inheritance of chlorotic mutant**

The $F_1$ plants of all the three crosses of normal with chlorotic mutant (Table 2) showed normal green leaves thus suggesting the dominance of normal green colour. The $F_2$ distribution pattern of the three crosses revealed two gene factors controlling this character. The observed ratios of 13 normal : 3 chlorotic in all the three crosses suggested that the two factors interacted in an inhibitory fashion. The genotypic symbols assigned to these genes are *Chl* (chlorotic) and *I* as inhibitory. The inhibitory gene, *I*, suppresses the expression of the dominant *Chl* gene when present together resulting in normal green colour of the leaves. The double recessive *(ii chlchl)* genotype also bears normal green leaves.

Table 2 : Mode of inheritance of chlorotic mutant

| Cross | Generation | Leaf colour: Normal | Leaf colour: chlorotic | Ratio | $x^2$ value | P value |
|---|---|---|---|---|---|---|
| 1. Pusa Bold(N)* | $F_1$ | 21 | — | — | — | — |
| × Chlorotic | $F_2$ | 213 | 42 | 13:3 | 0.869 | 0.25-0.50 |
| 2. Varuner (N) | $F_1$ | 35 | — | — | — | — |
| × Chlorotic | $F_2$ | 246 | 52 | 13:3 | 0.330 | 0.50-0.75 |
| 3. RLM 198(N) | $F_1$ | 16 | — | — | — | — |
| × Chlorotic | $F_2$ | 207 | 54 | 13:3 | 0.646 | 0.25-0.50 |

*N refers to normal leaf colour

## LITERATURE CITED

ASTHANA, A. N. AND SINGH, C. B. 1964. Advanced stigma mutant in rai (*B. juncea*) and yellow *sarson (B. campestris*). *Sci. & Cult.* 30 : 151-52.

SINGH, D. P. 1961. A new leaf mutant in rai (*B. juncea* Coss) *Curr. Sci.* 30 : 27-28.

J. Oilseeds Res. 1(1984) : 99-101

# GUIDELINES FOR AUTHORS

**General**

Review articles and original research papers concerning important developments of wide interest in any field of oil seeds will be considered for publication in Journal of Oilseeds Research. There will be two sections; one full paper and short communications. The responsibility for the contents of published articles rests with the author(s). Papers must not contain political statements or unsubstantiated assertions.

**Submission of manuscripts**

Submission of an article is understood to imply that the article is original and unpublished and is not being considered for publication elsewhere.

Papers for consideration should be submitted to

The Editor
Journal of Oilseeds Research
Directorate of Oilseeds Research
Rajendranagar
Hyderabad-500 030, India

**Preparation of Manuscript**

1. The official language of the journal is English.

2. Submit the original and two copies of your manuscript. Enclose the original illustrations and two sets of photo copies (three prints of any photograph).

3. Manuscripts should be typewritten, on one side of the bond paper, with two inches margins throughout including abstracts and literature cited. Every page of the manuscript should be numbered in the upper right hand corner, including title page, literature cited, tables etc. However, in the text no reference should be made to page numbers, if necessary one may refer to sections. Underline words that should be in italics.

4. When corrections are necessary, never follow the same rules as for proof correction.

5. Manuscripts should in general be organised in the following order : Title (please avoid long titles); Author(s) name(s); Affilliation(s); Abstract; Key words; Introduction; Material and Methods; Discussion (Results and discussion combined also), Acknowledgement; Literature Cited,

6. Editor reserves the privilege of returning the manuscripts and illustrations which are not according to the guidelines given here.

**Abstracts**

An abstract of not more than 400 words should be included with the manuscript. At the beginning of each abstract, provide the complete bibliography entry by which the paper will be referenced.

**Tables**

Each table should be typed on a separate sheet of paper at the end of manuscript. An indication of where the tables are to appear may be made in the text margin. Tables should be numbered according to their sequence in their text. The text should include all tables. Each table should have a brief and self explanatory title. Any explanation essential for understanding the table should be given as a foot note at the bottom of the table.

**Illustrations**

1. All illustrations should be given separately, unmounted and unfolded.

2. Illustrations should be numbered according to their sequence in the text. Reference should be made in the text to each figure.

3. Lettering should be in Indian ink or by printed labels. Make sure that the size of the lettering is big enough to allow a reduction of 50% without becoming illegible.

4. Each illustration should have a caption. The caption to all figures should be typed on a separate sheet of the manuscript.

**Literature cited**

1. All publications cited in the text should be presented in a list of Literature cited.

2. Use the following system for arranging your **references** :

a. For periodicals

BRADBURY, J. F. 1970. Isolation and preliminary study of bacteria from plants. *Rev. Pl. Path.* 49 : 213-218.

AGNIHOTRI, V. P., SEN, C. and SRIVASTAVA, S. N. 1975. Role of fungitoxicants in the control of *Sclerotium* root rot of sugarbeet, *Beta vulgaris* L. *Indian J. Exp. Biol.* 13 : 89-91.

b. For edited symposia, special issue etc.

BISWELL, H. H. 1974. Effects of fire on chaparral, pp 321-365. In fire and ecosystems Eds. T. T. Kozlowski and D. B. Ahlgrer. Academic press, New York.

c, For books

BARTIK, M and PISKAC, A. 1981. Veterinary toxicology. Developments in animal and veterinary sciences. Elsevier Scientific Publishing Company, Amsterdam/Oxford/New York, 346 pp.

**Nomenclature**

Authors and editors are by general agreement, obliged to accept the rules governing biological nomenclature as laid down in the International code of Nomenclature of Botanical, and the International code of Zoological Nomenclature.

For chemical nomenclature, the conventions of the International Union of Pure and Applied Chemistry and the official recommendations of the IUPAL- IUB combined Commission on Biochemical Nomenclature should be followed.

Edited and Published by Dr. Satyabrata Maiti for the Indian Society of Oilseeds Research, Directorate of Oilseeds Research, Rajendranagar, Hyderabad-30 and Printed at Poornakala Offset Printers, Hyderabad-20.