16.53 per cent in endosulfan 0.07% (Table 2). More larval mortality and less fruit damage in these treatments might be due to combined attack of all components (Narayanan and Gopalakrishnan, 1990) or an additive effect of neem products and NPV with endosulfan (Jayaraj *et al.*, 1985). Control registered 69.68 per cent fruit damage.

Rabindra and Jayaraj (1988) reported that application of NPV @250LE/ha in 20% crude sugar as ULV was found to be effective against *H. armigera* in chickpea. But in the present study, application of NPV @ 250LE/ha + 10% crude sugar did not give effective control. In the present study, combinations NSKE 3% and neem oil 3% with NPV @250LE/ha + endosulfan 0.035% were found to be highly effective in controlling *H. armigera* as that of endosulfan 0.07%.

The fruit yield was also maximum in these treatments. However, when the cost benefit ratio was considered, it was high in endosulfan 0.07% (1:13.64), NSKE 3% + NPV @250LE/ha (1.13.33), NSKE 3% + endosulfan 0.035% + NPV @250LE/ha (1:12.89) and NPV @250LE/ha + 10% crude sugar (1:12.74) (Table 2). Thus, integration of NPV of *Heliothis* with neem seed kernal extract and endosulfan may also be adopted in place of endosulfan 0.07% for the control of *H. armigera* and higher return in tomato.

REFERENCES

ABDUL KAREEM, A. (1980). Evaluation of neem products o the control of gram pod borer. **Pesticides 15:** 78.

HARI RAGHAVENDRA RAO, A., KAMESHWARA RAO, P and MANI, A. (1990). Management of gram pod borer *Heliothis armigera* (Hb.) with newer insecticides in pigeon pea. pp.119-126. **In: Heliothis Management Proceedings of National Workshop** (Jayaraj S. Uthamasamy, S., Gopalan, M. and Rabindra, R.J. Eds.) Centre for Plant Protection Studies, Tamil Nadu Agricultural University, Coimbatore.

JAYARAJ, S., RABINDRA, R.J. and NARAYANAN, K. (1985). Development and use of microbial agents for control of *Heliothis* Spp. (Lep : Noctuidae) in India. Paper presented in the **International Workshop on Biological Control of Heliothis : Increasing the Effectiveness of Natural Enemies.** Nov. 11 - 16, 1985, New Delhi.

NARAYANAN, K. and GOPALAKRISHNAN, C. (1990). Integrated control of *Heliothis armigera* (Hbn.) with their pathogens and pesticides in certain Horticultural crops. pp 165-176. In : **Heliothis Management Proceedings of National Workshop** (Jayaraj, S:, Uthamasamy, S., Gopalan, M. and Rabindra, R.J. Eds.), Centre for Plant Protection Studies, Tamil Nadu Agricultural University, Coimbatore.

RABINDRA, R.J. and JAYARAJ, S. (1988). Efficacy of NPV with adjuvants as high volume and ultra low volume application against *Heliothis armigera* (Hbn.) on chickpea. **Trop. Pest Management 34:** 441-444.

SANTHARAM, G., BALASUBRAMANIAN, M. and SUBBA RAO, P.V. (1981). Control of *Heliothis armigera* (Hubner) on redgram *Cajanus cajan* with the nuclear polyhedrosis virus and insecticides. **Madras Agric. J., 68 :** 417-420.

(Received : March 1996 Revised : August 1996)

Madras Agric. J., 84(2): 84-86 February 1997
https://doi.org/10.29321/MAJ.10.A00848

CORRELATION, REGRESSION AND PATH COEFFICIENT ANALYSIS IN RAINFED LINSEED

R.N.MAHTO and JAY LAL MAHTO

Regional Research Station
Birsa Agricultural University
Darisai

ABSTRACT

Nineteen linseed (*Linum usitatissimum*L.) genotypes were evaluated in 1990-91 to 1994-95 in five environments for seven characters. A high significant positive association had been observed between seed yield/plant and days to maturity. Plant height, number of primary branches/plant, number of secondary branches/plant and number of capsules/plant. Multiple regression equation revealed the importance of the number of primary branches/plant and number of capsules/plant for contribution to yield.

KEY WORDS : Correlation, linseed, *Linum usitatissimum*, path coefficient

Linseed (*Linum usitatissimum*L.) is predominantly a self- pollinated crop of industrial importance. The use of linseed oil in the manufacture of varnish and paints and its fitness in certain types of textiles and paper is well known. It is cultivated in India in over 2.0 million ha, but its average yield in this country is quite low (224 kg/ha). The production of this crop has therefore to

Table 1. **Correlation between different pairs of characters in rainfed linseed**

Characters	Days to maturity	Plant height	No.of primary branches/plant	No.of secondary branches/plant	No.of capsules/plant	Seed yield per plant
Days to 50% flowering	0.610*	0.359	0.650**	0.358	0.470*	0.511*
Days to maturity		0.713**	0.751**	-0.565*	0.639**	0.671**
Plant height			0.911**	0.119	0.494*	0.742**
Number of primary branches/plant				0.889**	0.811**	0.719**
Number of secondary branches/plant					0.793**	0.899**
Number of capsules/plant						0.633**

*,** Singnificant at 5% and 1% probability levles respectively.

be stepped up by evolving high yielding varieties. For evolving superior types, the plant breeder must know the relationship between yield attributes and their association with yield.

MATERIALS AND METHODS

Experiment was conducted with 19 linseed genotypes in randomised block design with 3 replications in 5 winter seasons during 1990-91 to 1994-95 under rainfed conditions at experimental area of Regional Research Station (NARP), Darisai under Birsa Agricultural University, Ranchi (Bihar). Each genotype was sown in 6 rows of 4 m length and spacing between plants and rows were maintained 30 and 10 cm respectively. The observations on seven characters *viz.*, days to 50% flowering, days to maturity, plant height, number of primary branches/plant, number of secondary branches/plant, number of capsules/plant and seed yield/plant were recorded. Correlation and multiple regression analyses were done as per method described by Snedecor and Cochran (1968) on pooled data and path co-efficient analysis done following Dewey and Lu (1959).

RESULTS AND DISCUSSION

Analysis of variance for all the characters revealed the significant differences among the genotypes. Seed yield/plant had a high significant and positive association with all the characters except days to 50% flowering (Table 1.). A high significant and positive association was observed between number of primary branches/plant and days to 50% flowering, days to maturity, plant height, number of secondary branches/plant and number of capsules/plant, days to maturity and plant height and number of capsules/plant. A high significant and positive relationship between number of secondary branches/plant and number of capsules/plant were also observed. Haque *et al.*, (1994) had reported similar result between number of capsules/plant and days to maturity. A significant positive correlation had been observed between days to 50% flowering and days to maturity and number of capsules/plant, and plant

Table 2. **Individual and multiple regression equation in linseed under rainfed environments**

Individual and multiple regression equation	Contribution to seed yield (%)
$\hat{Y} = 8.913^{**} + 0.798\ X_1^{**}$ (Days to 50% flowering)	89.83
$\hat{Y} = 9.123^{**} + 0.899\ X_2^{**}$ (Days to maturity)	93.53
$\hat{Y} = 9.312^{**} + 0.632\ X_3^{*}$ (Plant height)	94.39
$\hat{Y} = 9.212^{**} + 0.800\ X_4^{**}$ (Number of primary branches/plant)	95.19
$\hat{Y} = 9.519^{**} + 0.799\ X_5^{**}$ (Number of secondary branches/plant)	98.91
$\hat{Y} = 9.931^{**} + 0.988\ X_6^{**}$ (Number of capsules/plant)	93.39
$\hat{Y} = 12.391^{**} + 0.795\ X_1^{**} + 0.892\ X_2^{**} + 0.630\ X_3^{*} + 0.797\ X_4^{**} + 0.790\ X_5^{**} + 0.980\ X_6^{**}$	98.79
$\hat{Y} = 12.412^{**} + 0.798\ X_1^{**} + 0.895\ X_2^{**} + 0.799\ X_4^{**} + 0.791\ X_5^{**} + 0.982\ X_6^{**}$	91.02
$\hat{Y} = 12.481^{**} + 0.799\ X_1^{**} + 0.895\ X_2^{**} + 0.899\ X_4^{**} + 0.985\ X_6^{**}$	81.93
$\hat{Y} = 12.539^{**} + 0.898\ X_2^{**} + 0.892\ X_4^{**} + 0.987\ X_6^{**}$	79.88
$\hat{Y} = 12.557^{**} + 0.899\ X_4^{**} + 0.999\ X_6^{**}$	68.59

*, ** Significant at 5% and 1% probability levels respectively.

Table 3. Path analysis in linseed for different characters

Characters	Days to 50% flowering	Days to maturity	Plant height	No.of primary branches/ plant	No.of secondary branches/ plant	No.of capsules/ plant	Correlatio with seed yield/plan
Days to 50% flowering	0.651	-0.459	-0.270	-0.221	0.591	0.329	0.511*
Days to maturity	-0.119	0.790	-0.263	-0.240	-0.315	0.818	0.671**
Plant height	-0.130	-0.102	0.539	-0.096	-0.104	0.635	0.742**
No of primary branches/Plant	-0.200	-0.312	-0.120	-0.801	0.331	0.219	0.719**
No.of secondary branches/plant	-0.101	-0.103	-0.095	0.666	0.321	0.211	0.899**
Number of capsules/plant	-0.339	0.333	-0.350	0.211	-0.209	0.987	0.633**

Underlined figers denote the direct effect Residual effect R = 0.447.

height and number of capsules/plant. The present findings are in conformity with the results of Verma *et al.*, (1994) in linseed. A significant and negative interrelation had been found between days to maturity and number of secondary branches/plant.

Individual regression equation revealed the contribution of days to 50% flowering (89.83%), days to maturity (93.53%), plant height (94.39%), number of primary branches/plant (95.19%), number of secondary branches/plant (98.91%) and number of capsules/plant (93.39%) to the seed yield/plant (Table 2). Multiple regression equation expressed positive partial regression for all characters. Patil *et al.*, (1989) had observed positive partial regression coefficient for plant height in linseed whereas Mahto (1995) had observed the positive partial regression for plant height, number of branches/plant, days to 50% flowering, number of capsules/plant and days to maturity in linseed. Equation based on all characters had 98.79 per cent contribution towards seed yield, whereas days to 50% flowering, days to maturity, number of primary branches/plant, number of secondary branches/plant and number of capsules/plant contributed 91.02 per cent to seed yield. Only two characters *viz.*, number of primary branches/plant and number of capsules/plant had 68.59% contribution to seed yield thereby showing their importance for selection purpose in this crop.

Path analysis revealed the highest direct effects of number of capsules/plant followed by number of primary branches/plant, days to maturity and day to 50% flowering (Table 3). Number capsules/plant and number of primar branches/plant had a high significant positiv association with seed yield and in multipl regression equation 68.59 per cent contribution t seed yield/plant and had a high positive dire effect on seed yield/plant in path analysis. F number of primary branches/plant, Haque *et a* (1994) had also reported high direct effect. revealed the importance of number o capsules/plant and number of primar branches/plant. Hence these must be taken int consideration while making a programme fo linseed improvement.

REFERENCES

DEWEY, J.R. and LU,K.H.(1959). A correlation and path coefficient analysis of components of crested wheat seed production. **Agron.J., 51**: 515-518.

HAQUE, M.F., SRIKANT SINGH and MAHTO, J.L. (1994). Correlation and path coefficient analysis in linseed. **J.Res.BAU., 6**: 81-83.

MAHTO, J.L.(1995). Multiple regression study in linseed under dryland environment and yield attributes. **Madras Agric.J., 82**:213- 214.

PATIL, R.R., SINHA, M.N. RAI, P.K. and PRASAD,M. (1989). Correlation and regression analysis in linseed. **Indian J.Agric.Sci., 49**: 578-91.

SNEDECOR, G.W. and COCHRAN, W.G.(1968). **Statistical Methods.** Oxford & IBH Pub. Co. New Delhi.

VERMA, A.K., SINHA, and MAHTO, J.L.(1994). Correlation studies between yield and some components in linseed. **Natl.Symp. on Frontiers in Plant Sci. Res.,** Feb 13-14, 1994. 129 pp. (Abstract).

(Received : May 1996 Revised : September 1996)

REFERENCES :

BECKER, M., LADHA, J.K. WATANABE, I. and OTTOW, J.C.G. (1988). Seedling Vs vegetative probacation of the stem nodulating green manure *Sesbania rostrata*. **Biol. Fertil. Soils 6: 279-281.**

BOULDIN, D.R. (1988) **Proceedings of a Symposium on Sustainable Agriculture - Green Manure in Rice Farming pp. 151-164.**

FUROC, R.E. and MORRIES, R.A. (1989). Apparent recovery and physiological efficiency of nitrogen in *Sesbania* incorporated soil. **Agron J., 81 :** 797-802.

GOPALASWAMY, G., VIDHYASEKARAN, P. and CHELLIAH, S, (1989). Effect of *Azosprillum* inoculation on growth and yield of rice. **Indian J. Agric. Sci., 59 :** 600-602.

(Received : May 1996 Revised : July 1996)

Madras Agric. J., 84(2): 89-91 February 1997

G X E INTERACTION IN SHORT DURATION RICE

W.WILFRED MANUEL, P.VIVEKANANDAN and T.B.RANGANATHAN

Tamil Nadu Rice Research Institute
Tamil Nadu Agircultural University
Aduthurai 612 101

ABSTRACT

Five short duration rice genotypes *viz.*, ADT 36, ADT 41, ADT 42, IR 72 and AD 85361 were studied for stability performance under three nutrio-environments *viz.*, O (E_1), 100 kg N ha^{-1} (E_2) and 200 kg N ha^{-1} (E_3) for 18 characters. G x E interaction was significant for four characters only *viz.*, spikelets $panicle^{-1}$, grains $panicle^{-1}$, 100-grain weight and grain yield ha^{-1}. Genotypes ADT 36 and AD 85361 were the most stable and consistent ones for the traits studied in all environments.

KEY WORDS : Genotype, nutrio-environments, stability, regression

G x E interactions are important in identifying stable genotypes that interact less with the environments in which they are grown. If stability of performance or the ability to show a minimum interaction with environment is a genetic characteristic, then preliminary evaluation could be planned to identify stable genotypes. Low and high plant population or medium and high rates of fertilizers can be used to increase the number of environments possible from a fixed number of locations, and at the same time provide a greater range of environmental conditions (Eberhart and Russell, 1966) An ideal widely adapted and stable genotype is the one with high mean performance, average responsiveness to environment (b=1) and high stability ($S^{-2}di = 0$).

MATERIALS AND METHODS

Five short duration rice genotypes *viz.* ADT 36, ADT 41, and 42, IR 72 and AD 85361 were studied to assess their stability of performance under three N levels *viz.*, O (E_1), 100 kg ha^{-1} (E_2) and 200 kg ha^{-1} (E_3) in randomised block design with two replications during June to October 1994 at the Tamil Nadu Rice Research Institute, Aduthurai, Tamil Nadu. Observations were recorded for 18 characters *viz.*, plant height, panicles $plant^{-1}$, panicle length, spikelets $panicle^{-1}$, grains $panicle^{-1}$, spikelet fertility, 100-grain weight, grain yield ha^{-1}, spikelet growth factor (SPGF) kg^{-1} leaf area $plant^{-1}$ (at flowering), leaf weight ha^{-1} (at harvest), stem weight ha^{-1} (at harvest), root weight ha^{-1} (at harvest), panicle weight ha^{-1} (at harvest), total dry matter production (TDMP) ha^{-1} (at harvest), and leaf N (at panicle initiation, flowering and harvest). Statistical constants of mean for all the characters, and regression coefficient (bi) and deviation from regression ($S^{-2}di$) for the characters where G x E interaction was significant were estimated following the method proposed by Eberhart and Russell (1966).

RESULTS AND DISCUSSION

G x E interaction was highly significant for four characters only *viz.*, spikelets $panicle^{-1}$, grains $panicle^{-1}$, 100-grain weight and grain yield ha^{-1} for which stability parameters were estimated. Of the two components of G x E interaction, G x E (linear) was highly significant for spikelets $panicle^{-1}$, 100-grain weight and grain yield ha^{-1}, indicating significant differences among the genotypes for linear response to environments (b values), while pooled deviation was highly significant for grains $panicle^{-1}$, indicating significant differences among genotypes for non-linear response to environments (stability)