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Effect of Fertilization on Yield and Nutrient Concentration of Black Gram (*Phaseolus mungo* L.)

By

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ABSTRACT

Blackgram was grown in red soil of Coimbatore under varying levels of N, P and rhizobium. The yield of seed was found to increase with increase in level of N and P whereas the dry matter production was influenced by P levels only. The crude protein and total P content of seed were found to increase with levels of N and P respectively.

INTRODUCTION

Black gram is one of the most important pulse crops of Tamilnadu. It is mostly rainfed and scarcely manured resulting in low yield. The lower productivity of this crop can be doubled by growing it under proper fertilization and irrigation. The dhals of blackgram is found to be richer in many of the proximate and ultimate constituents. Research work on the above mentioned aspects is scanty in this State. Hence the present study was undertaken to know the influence of fertilization on the yield and nutrient concentration of blackgram.

MATERIALS AND METHODS

Blackgram variety Pusa 1 was grown in a non-calcareous red soil of Coimbatore under pot culture condition. There were three levels of nitrogen 0,30 and 60 kg N/ha and four levels of phosphorus 0, 30, 60 and 90 Kg P_2O_5/ha Ammonium sulphate and labelled superphosphate with P^{32} were used as fertilizers. Rhizobial culture specific to blackgram was used to treat the seeds sown in half number of pots. Muriate of potash was applied at 30 kg K_2O/ha for all the pots. There were 24 treatments per replication and there were two replications. Dry-matter production at flowering and post-harvest stages besides seed yield was recorded.

The bulk soil used for the study was poor in available nitrogen, phosphorus and potash with neutral reaction. The seed samples were analysed for total nitrogen by Microkjeldahl method (Humphries, 1956). The total N value was multiplied by 6.25 to get

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the crude protein content. The total phosphorus was estimated colorimetrically by the method of Koenig and Johnson (1942). The yield and analytical data were statistically scrutinised.

RESULTS AND DISCUSSION

The plant shoot weight at flowering and post harvest stages were significantly increased by phosphorus application only (Table 1). P_3 and P_2 levels were superior to P_1 and P_0 levels which were on par. The application of phosphatic fertilizer in smaller amounts may not be sufficient for the plant growth in a low P level soil Similar yield response for increase in shoot weight for the P application was reported by Anand Prakash (1969). Significant treatment differences could not be obtained either for nitrogen or for rhizobial treatment.

TABLE 1. Yield of plant dry matter (in ten mg/pot)

P Levels	Mean yield	
	Flowering stage shoot	Post-harvest shoot
P_0	27.17	56.25
P_1	39.67	82.83
P_2	66.50	136.50
P_3	118.83	228 50
S. E.	7.7	13.0
C. D.	22.53	38 0

Significant treatment differences for levels of nitrogen, phosphorus and interaction between nitrogen and phosphorus were recorded in seed yield (Table 2). For the levels of nitrogen, N_2 was superior to the remaining levels which were on par The seed yield has been found to increase significantly with increase in levels of P. This could be due to the low available nutrient status of the soil. Such positive yield response for the application of nitrogen and phosphatic fertilizers were reported

TABLE 2. Seed yield (in ten mg/pot)

P levels	Nitrogen levels			Mean
	N_0	N_1	N_2	
P_0	55.2	61.2	61.5	59.3
P_1	84 5	84 5	99.0	89.3
P_2	119.0	136.0	176.0	143.7
P_3	244.3	220.0	276.0	246.7
Mean	125.7	125.5	152.5	

S. E. 4.7
C. D. 13.7

S. E. 4.1
C. D. 11 9
N × P S. E. 8.1
C. D. 23.7

by many workers and recommended N and P fertilizers in the manurial schedule (Kanwar Singh and Virk, 1965 and Rajagopalan *et al.*, 1970).

The lack of response due to the rhizobial inoculation might be due to the low microbial population of the soil (18×10^4 number/g of dry soil). There might be some unfavourable soil condition including soil antagonistic organism similar to those reported by Iswaran *et al.* (1970) and Mohammed Sheriff *et al.* (1970) in Coimbatore red soil. A detailed study in depth is necessary for understanding the causes for the lack of response for the inoculation of rhizobia.

The crude protein content of seed sample was found to vary from 22.8 to 28.0 per cent. Significant treatment differences were noted for levels of nitrogen only (Table 3). N_1 level was on par with N_2 but superior to N_0 level. This suggests the fact that the applied nitrogen might have been translocated to the seed and hence the content increased. This is in accordance with the results of Kesavan and Morachan (1973).

TABLE 3. Crude Protein content
[Percentage transformed into inverse sine value]

Levels of Nitrogen	Mean
N_0	30.005
N_1	30.853
N_2	30.718
S. E. of mean	0.201
C. D.	0.417

The total phosphorus content of seed samples varied from 0.100 to 0.368 per cent. Significant treatment differences were observed for levels of phosphorus only (Table 4). P_3 was superior to P_1 followed by P_2 and P_0 levels, the latter two were on par. The applied phosphorus might have translocated and hence the content might have increased. Danaraju (1972) and Singh (1972) reported that the phosphate application increased the total phosphorus content of soybean and daincha seed samples respectively.

TABLE 4. Total phosphorus content
[Percentage transformed into inverse sine value]

Levels of Phosphorus	Mean
P_0	2.342
P_1	2.561
P_2	2.357
P_3	2.789
S. E. of mean	0.087
C. D.	0.180

REFERENCES

ANAND PRAKASH, 1969. Soil and foliar application of Phosphate. *Proc. of Third Annual Workshop Conference on Pulse Crop.* I. A. R. I. New Delhi.

DANARAJU, S. 1972 *Effect of phosphorus and molybdenum on the availability of nutrients, yield, uptake and quality of soybean in black and red soils of Tamil Nadu.* M. Sc. (Ag.) Dissert. Tamil Nadu Agric. University.

HUMPHRIES, E. C. 1956. Mineral component and ash analysis. *Modern methods of plant analysis,* Spronger Verlag, Berlin, 1 : 468 – 502.

ISWARAN, V. W., V. B. SUNDARA RAO, N. S. SUBBA RAO, V. R. BALASUNDARAM and R. G. APTE. 1970. Nodulation of Soybean in Coimbatore Soil. *Curr. Sci* 39 : 491 - 2.

KAWAR SINGH and J. S. VIRK. 1965. A note on the effect of cultural and manurial treatments on the growth and yield of Mash and Moong Crop on alluvial soil. *Indian J. Agron.* 10 : 50.

KESAVAN, G. and Y. B. MORACHAN. 1973. Response of soybean varieties to graded doses of nitrogen and phosphorus. *Madras agric. J.* 60 : 23 - 6.

KOENIG, R. A. and C. R. JOHNSON. 1942. Colorimetric determination of phosphorus in biological materials. *Indian Eng. Chem. Anal. Ed.* 14 : 155.

MOHAMED SHERIFF, R., R. RATHNASWAMY, G. SELVAKUMARI, A. RAGUPATHY and R. H. KRISHNAN. 1970. Effects of bacterial inoculation for pulses cultivated in Tamil Nadu. *Madras agric. J.* 57 : 181—5.

RAJAGOPALAN, C. K., K. VENUGOPAL and N. MOHAMED SHERIFF. 1970. An economic manurial schedule for dryland black gram *Madras agric. J.* 57 : 271—3.

SINGH, R. G. 1972. Effect of phosphate and seed yield of daincha. *Indian J. agric. Sci.* 42 : 139 - 44.

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Effects of Virus Infection on the Yield Components of Black Gram

BY

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ABSTRACT

The study to assess the adverse effects of infection by Black gram mosaic virus [BMV] and Black gram sterility mosaic virus [BSMV] on the yield components of black gram indicated that both viruses caused significant reduction in height and shoot weight of infected plants. The reduction in height was positively correlated with loss of grain weight. The weight and length of roots of infected plants were not altered significantly. The number and weight of nodules were considerably reduced due to virus infection. Remarkable reduction in number of pods and weight of grains caused by virus infection was observable. A regression equation to predict the loss in yield based on growth retardation has been formulated.

INTRODUCTION

The adverse effects of virus infection on growth and yield of plants have been reported by different workers. However, attempts to obtain quantitative measurements of damage caused by viruses appear to be very few. As such studies help to estimate the loss due to virus diseases, the present investigations on virus diseases affecting black gram (*Phaseolus mungo* L.) were undertaken and the results reported in this paper.

MATERIALS AND METHODS

The black gram variety CO 1 plants were inoculated with infective sap obtained by grinding the leaves infected by Black gram sterility mosaic virus (BSMV) and Black gram Mosaic virus (BMV) separately with 0.1 M phosphate buffer at pH 7.0 and expressing the sap through cheese cloth. The test plants at 15, 30 and 45 days of age were inoculated using carborundum as abrasive. The measurements of various yield components viz., (i) height of plants (cm), (ii) weight of shoot (g), (iii) length of roots (cm) (iv) weight of root (g), (v) number of nodules, (vi) weight of nodules (g), (vii) number of pods and (viii) weight of grains (g) were taken and analysed statistically.

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TABLE 1. Effect of virus infection on height and shoot weight of black gram plants

Virus inoculated	Age of plants at inoculation (days)	Height (cm)	Per cent of increase or decrease (+ or −)	Weight of shoot (g)	Per cent of increase or decrease (+ or −)
BSMV	15	53.60	−50.76	13.52	−27.16
	30	69.70	−35.97	14.78	−20.37
	45	91.96	−15.52	16.58	−10.67
BMV	15	55.78	−49.31	22.16	19.39
	30	73.00	−32.94	18.84	1.51
	45	90.70	—16.68	21.18	14.12
Control (uninoculated)		108.86		18.56	
'F' test		**		**	

** Significant at 1 % level

TABLE 2. Effect of virus infection on length and weight of roots of black gram plants

Virus inoculated	Age of plants at inoculation (days)	Length (cm)	Per cent of increase or decrease (+ or −)	Weight of roots (g)	Per cent of increase or decrease (+ or −)
BSMV	15	17.34	−24.72	0.86	−53.26
	30	27.70	18.88	1.62	−11.96
	45	25.76	10.56	1.40	−23.91
BMV	15	27.08	16.22	1.52	−17.39
	30	24.74	6.18	1.46	−20.65
	45	28.50	22.32	1.92	4.35
Control (uninoculated)		23.30		1.84	
'F' Test		N. S.		N.S.	

RESULTS AND DISCUSSION

The data presented in Table 1 show that there was significant reduction in the height of plants due to infection by both viruses included in the present study. The adverse effect on height of the infected plants was progressively reduced as the age of the plants at the time of infection increased. The reduction in the height of BSMV-infected plants was in the magnitude of 50.76 per cent over control when the plants were infected at 15 days of age, while the plants infected later (45 days old) showed only 15.52 per cent reduction over control. The shoot weight of plants was also reduced due to infection by BSMV, while a slight increase in shoot weight was registered in the case of plants infected by Black gram mosaic virus.

The length and weight of roots did not show statistically significant variations when infected by either viruses (Table 2.). The virus-induced alterations in the root nodules formed on the infected plants were remarkable (Table 3). The number of root nodules formed on the plants inoculated with BSMV at 15 days of age showed a reduction of 71.33 per cent over control, whereas the plants inoculated at the age of 45 days exhibited 54.55 per cent reduction over the control. The adverse effect on the number of nodules formed appeared to decrease as the age of plants at the time of inoculation increased. The nodule weight was also reduced considerably, the percentage of decrease ranging from 58.22 to 73.68. In the case of black gram plants infected by BMV, the reduction in both the number of nodules and the weight of nodules was observed. A maximum reduction of 79.02 percent in the number of nodules and 82 57 per cent in the weight of nodules was exhibited by BMV-infected plants.

The cumulated adverse effects on the different yield components will influence the yield of the virus-infected plants. The number of pods produced in plants infected with BSMV was greatly reduced when infection occurred at 15 days of age and the percentage of reduction in the number of pods was reduced from 43.75 to 18.75 when the age of plants at the time of inoculation increased to 45 days (Table 4). The reduction in the weight of grains in BSMV-infected plants was progressively reduced with increase in the age of plants, the percentage of reduction decreasing from 70.78 to 39 63. BMV was also able to induce perceptible reduction in both the number of pods and weight of grains in the infected plants. The percentages of reduction in both attributes were higher, if the plants were infected earlier.

The virus diseases are known to induce characteristic changes in infected plants, of which stunting of plants due to retarded growth is frequently observed. The infection of plants at early stage of growth has been reported to cause greater reduction in height of plants and yield (Shinkai, 1962; Watson and Heathcote, 1965; Palomar and Ling, 1968; Ishii *et al.*, 1970). In black gram stunting of plants due to infection by BSMV and BMV was observed. The height of the plants was

TABLE 3. Effect of virus infection on number and weight of root nodules in infected black gram plants

Virus inoculated	Age of plants at inoculation (days)	No. of nodules	Per cent of increase or decrease [+ or −]	Weight of nodules [g]	Per cent of increase or decrease [+ or −]
BSMV	15	8.2	−71.33	0.0086	−71.71
	30	12.8	−55.24	0.0080	−73.68
	45	13.0	−54.55	0.0127	−58.22
BMV	15	12.8	−55.24	0.0,04	−32.89
	30	6.0	−79.02	0.0096	−68.42
	45	7.2	−74.83	0.0053	−82.57
Control [uninoculated]		28.6		0.0304	
'F' Test		**		**	

* Significant at 5% level ** Signifcant at 1% leve

TABLE 4. Effect of virus infection on number of pods and weight of grains in infected black gram plants

Virus inoculated	Age of plants at inoculation [days]	No of pods	Per cent of increase or decrease [+ or −]	Weight of grains [g]	Per cent of increase or decrease [+ or −]
BSMV	15	9	−43.75	1.027	−70.78
	30	9	−43.75	1.560	−55.62
	45	13	−18.75	2.122	−39.63
BMV	15	5	−68.75	1.073	−69.47
	30	12	−25.00	1.675	−52.35
	45	12	−25.00	1.841	−47.62
Control (uninoculated)		16		3.515	
'F' Test		**		**	

** Significant at 1 per cent level

positively correlated with the weight of grains in affected plants (Fig. 1). The reduction in height of infected plant can be used to predict the loss in yield of grains by using the following formula, $\frac{(H_1 - H_2) \times 100}{H_1}$ where H_1 and H_2 are the means of height of healthy and infected plants respectively. This value for reduction in height of the diseased plants is then substituted for 'X' in the following regression equation,

$$\hat{Y} = 25.94 - 0.882 \times$$

to get the percentage of loss in yield of grains (Y). Ling (1972) suggested the use of degree of growth retardation as represented by reduction in height of plants to estimate the loss in yield.

The effects of virus infection on the development of root system and nodules in leguminous plants have been reported (John, 1959; Kousalya *et al.* 1967. The BSMV and BMV did not cause any significant reduction in length and weight of roots of black gram plants. Marked reduction in the number and weight of nodules due to infection by BSMV and BMV was noticed. While the formation of nodules is influenced by several factors the virus infection may bring about changes in the physiology of the affected host plants which may be responsible for the lower number of root nodules and reduced nodule weight observed in the infected plants The infected legumes not only fail to produce as much as the healthy plants but are able to add only small amounts of nitrogen due to the poor development of nodules in the infected plants.

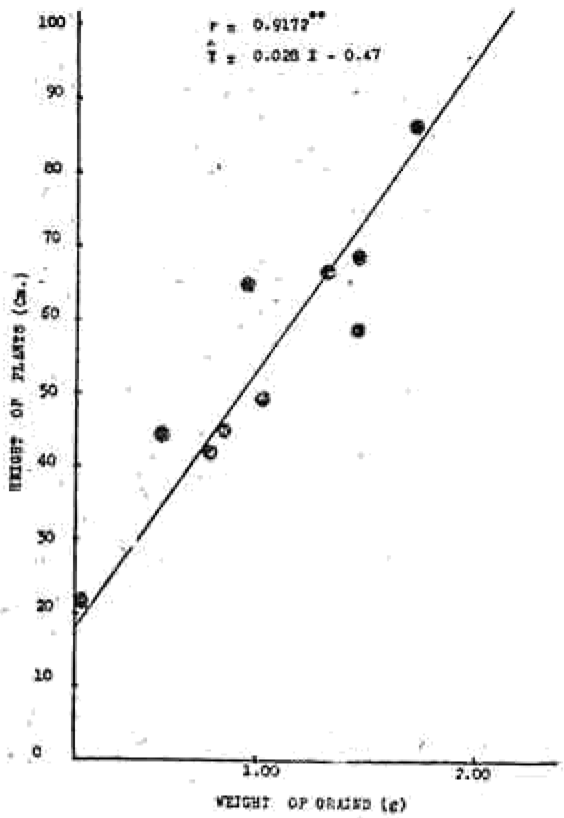

Fig 1. Correlation between height of infected plants and grain yield.

REFERENCES

ISHII, M., S. YASUO and T. YAMAGUCHI. 1970. Epidemiological studies on rice dwarf disease in Kanto-Tosan district, Japan. *J. Cent. Agr. Exp. Sta.* **14** : 1—115.

JOHN, V. T. 1959. Root and nodule development in *Dolichos lab-lab* L. infected with *Dolichos* enation mosaic virus. *Curr. Sci.* **28** : 24.

KOUSALYA, G., S. BHASKARAN and C. S. KRISHNAMURTHY. 1967. Assessment of crop losses caused by rosette disease of of groundnut. *Indian J. agric. Sci* **37** : 356—61.

LING, K. C. 1972. *Rice virus diseases.* International Rice Research Institute, Los Banos, Philippines. p. 141.

PALOMAR, M. K. and K. C. LING. 1968. Yield losses due to grassy stunt infection. *Philippine Phytopathol,* **4** : 14

SHINKAI, A 1962. Studies on insect transmission of rice viruses in Japan. *Nat. Inst. Agr. Sci. Bull. Ser. C.* **14** : 1—112

WATSON, M. A. and G. D. HEATHCOTE. 1965. The use of sticky traps and the relation of their catches of aphids to the spread of viruses in crops. *Rept. Rothamsted Exptl. Sta.* pp 292—300.

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Response of Green Gram to Seasons and Graded Doses of Nitrogen and Phosphorus Fertilizers

BY

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ABSTRACT

In two varieties of green gram, viz Rajendran and Pusa-Baisakhi moong, the effects of seasons and graded doses of nutrients (nitrogen and phosphorus) were studied. Pusa-Baisakhi moong was found high yielding. Of the seasons, *kharif* was good for cultivation of green gram and winter was quite unfavourable. Nitrogen levels had no significant effect on seed yield. Phosphorus at 20 kg P_2O_5 / ha resulted in higher economic yield and further additions of phosphorus to 40 and 60 kg P_2O_5 / ha caused reduction in seed yield. The per day production of Pusa-Baisakhi moong was found to be 15 kg / ha in *kharif* and this appears highest among pulses under Tamil Nadu conditions.

INTRODUCTION

High yielding short duration varieties of green gram offer the greatest scope in raising the pulses production substantially. Pusa-Baisakhi moong, a high yielding short duration green gram, has been recommended as an all India variety. Recently in Tamil Nadu, a pureline selection of green gram has has been released for cultivation with the name 'Rajendran'.

Of the growth factors, the season is reported to have a striking iufluence on the yields of green gram (Misra, 1973). Most manurial experiments with green gram conducted throughout India reveal in general, a poor response to added fertilizers (Rajendra Prasad, 1968 and Chandra *et al.*, 1972). With the outcome of new high yielding, short duration varieties of green gram, the effects of fertilizer nutrients and seasons on their cultivation need a thorough investigation to come out with specific reccmmendations.

MATERIALS AND METHODS

With two varieties of green gram, Rajendran and Pusa-Baisakhi moong, field studies were conducted at the Agricultural College Farm, Coimbatore. The soil was sandy clay loam type having 330, 22 and 914 kg of available NPK ha respectively. A split plot design was adopted for the study, assigning the levels of nitrogen (0, 10, 20 and 30 kg N/ha) and the levels of phosphorus (0, 20, 40 and 60 kg P_2O_5/ha)

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TABLE 1. Varietal differences in plant growth characteristics

Varieties	Plant height in cm [mean values]						Leaf area [cm²]	Leaf area index	Total dry matter production (kg/plot)	
	Kharif			Winter						
	Pre-bloom	Bloom	Maturity	Pre-bloom	Bloom	Maturity			*Kharif*	Winte
Rajendran	9.70	23.16	60.50	13.86	26.77	49.10	287 08	1.91	2 326	1.207
Pusa-Baisakhi moong	7.70	23.02	28.40	12.68	25.58	27.39	204.89	1.37	1.528	0.760
S. E.	0.18	0.21	0.19	0.18	0.20	0.60	6.8		0.033	0.032
C. D. [5%]	0.52	0.61	0.55	0.52	0 58	1.73	19.62		0.095	0.092

TABLE 2. Influence of N and P levels and varietal differences on seed yield

Varieties	Mean yield [kg/ha]	Levels of nitrogen	Mean values [kg/ha]	Levels of phosphorus	Mean values [kg/ha]	Levels of phosphorus	Actual yield [kg/ha]	Predicted yield [kg/ha]
Rajendran	502	N_0	731.6	P_0	698.3	P_0	698.3	698.7
Pusa-Baisakhi moong	989	N_1	732.6	P_1	781.6	P_1	781.6	781.1
		N_2	750.4	P_2	731.1	P_2	732.1	731.5
		N_3	729 3	P_3	731.1	P_3	732.1	729.0

Varieties: S. E – 10.11; C. D [at 5%] – 29 Levels of N and P: S. E - 12.7; C. D [at 5%] - 36.9

to main plots and the two green gram varieties to sub-plots. The experiment was conducted in two seasons viz. *kharif* and winter 1972-73 under irrigated conditions. 2.5 × 3 0 m plots were formed. Seeds were dibbled in rows, with a spacing of 30 × 10 cm. The gross and net area of the plots were 7.5 and 5.4 sq. m. respectively. The *kharif* season crop was sown on

21—7—72 and harvested on 21-9-72. The winter season crop was sown on 22—10—73 and harvested on 23—12—73.

The growth and yield characteristics such as plant height, leaf area index, dry matter production and seed yield were studied. For the seed yield, the response curve was fitted and the economics of phosphorus fertilization worked out.

RESULTS AND DISCUSSION

1. Plant height: The variety Rajendran grew taller than Pusa Baisakhi moong. The striking difference was that Rajendran attained a new peak in plant height after the bloom stage whereas Pusa-Baisakhi moong remained relatively unaffected after the bloom stage (Table 1).

2. Leaf Area Index: The leaf area index of Rajendran was significantly higher than Baisakhi moong. In Rajendran the leaves were found crowded at late-bloom stages enabling mutual shading (Table 1). Such mutual shading was relatively much less in Baisakhi moong.

3. Total Dry Matter: The variety Rajendran produced dry matter, nearly one and half times of that of Baisakhi moong (Table 1). The effect of seasons was very apparent. Dry matter production was nearly double in *kharif* season as compared to winter. The low temperature and the very low humidity prevailed during winter season might have been the probable causes for the drastic reduction in dry matter production. This view is in agreement with Brouwer (1960) who observed dry matter increase with high temperature.

4. Seed Yield: The mean seed yield of Baisakhi moong is almost double to that of Rajendran (Table 2). The yield difference to the applied levels of nitrogen was found non-significant (Table 2). Absence of significant response to nitrogen was reported by many workers (Saxena, 1969; Joshi, 1968 and Sharma and Misra, 1961).

Phosphorus levels had significant influence on seed yield (Table 2). Phosphorus applied at P_1 level (20 kg P_2O_5/ha) has given an yield increase of 83 kg per ha over control. The response to higher doses of phosphorus viz. P_2 and P_3 level (40 kg and 60 kg P_2O_5/ha) was only 50 kg seed yield per ha. As the present investigation was carried out in a calcareous sandy loam soil, medium in available phosphorus, the yield increases to the addition of fertilizer phosphorus were meagre. This view is in agreement with the finding of Rajendra Prasad (1968).

The effect of season on seed yield was highly significant. A three fold decrease has resulted in the winter season crop. The weather prevailed in the winter season was quite unfavourable for better crop production. The cool, rainless dry winter prevailed during the growth period would have reduced the dry matter production. The cool night temperatures, high day time temperature and the very low humidity in winter would have reduced the period of flowering and especially the period of filling. Further, the weather prevailed during winter has favoured the incidence of pests and diseases, especially virus right at the time of flowering and maturity stage. With the result, Baisakhi moong gave poor yield (325 kg/ha) and Rajendran failed to yield at all in the winter season. In *kharif*, the per day, per ha production of Baisakhi moong was found to be 15 kg seed yield and this appears highest among pulses.

5. Response function and Economic dosage: To study the pattern of response of seed yield to successive doses of phosphorus, response curve was fitted. Cubic trend was found to be appropriate to represent the dose-response relationship. The response equation is

$$\hat{Y} = 0.00378 - 0.39392 X^2 + 10.52564 X + 698.76$$

The observed and predicted yields are presented in Table 2. The P_1 level (20 kg P_2O_5/ha) was found to be the economic dosage. Upto P_1 level for every kg of P_2O_5 added, there is a gain of 4 kg extra seed yield. In terms of money value, for every rupee spent on fertilizer phosphorus, there is a net return of three rupees and hence a worthy investment

REFERENCES

BROUWER, A. D. 1960. The influence of temperature on the development of peas. *Field crop Abstr.* 13 : 117.

CHANDRA, S., V. P. GUPTA and V. N. MISHRA. 1972. Mung-varietal and manurial trials. *Proceedings of the sixth annual workshop conference on pulses.* UAS Bangalore

JOSHI, S. N. 1968. Manuring of pulses. *Proceedings of third annual workshop on pulses* IARI New Delhi.

MISRA, R. C. 1973. Profitable cultivation of summer pulses. *Indian Farmers Digest.* 4 : 41.

RAJENDRA PRASAD. 1968. Green gram manurial trials - a review. *Proceedings of the second annual workshop conference on pulse crops.* IARI - New Delhi.

SAXENA, C. 1969. Experiments on pulse crops at UPAU, Pantnagar. *Proceedings of third annual workshop conference on pulses.* IARI, New Delhi.

SHARMA, J. N. and K. P. MISRA. 1961. Response of different levels of nitrogen and phosphate on yield of peas under rainfed conditions. *Indian J. Agron.* 5 : 256-61.