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RESEARCH ARTICLE

INFLUENCE OF GRADED LEVELS OF NITROGEN AND PHOSPHORUS ON GROWTH AND YIELD OF BITTER GOURD (*Momordica Charantia* L.) ECOTYPE 'MITHIPAGAL'UNDER RICE FALLOW OF CAUVERY DELTA REGION

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ABSTRACT

A study on influence of graded levels of nitrogen and phosphorus on growth and yield of bitter gourd ecotype 'mithipagal' under rice fallow of cauvery delta region was carried out in the faculty of Agriculture, Annamalai university, Tamilnadu The experiment comprised of twelve treatment combinations having the four levels of nitrogen (0, 30, 60 and 90 kg ha^{-1}) and three levels of phosphorus (0, 15 and 30 kg ha^{-1}) under factorial randomized block design with four replications. Potassium @ 30 kg ha^{-1} was applied in all treatments as constant dose except the control. Among the graded levels, N_3P_2 (nitrogen 90 kg ha^{-1} + phosphorus 30 kg ha^{-1}) registered the maximum values in growth parameters *viz.,* vine length, number of branches $plant^{-1}$, number of leaves $plant^{-1}$. However, it was closely followed by N_2P_2. Regarding the yield attributes, the treatment combination N_3P_2 showed the maximum values in fruit weight, fruit yield $plant^{-1}$ (1.21 kg) and fruit yield ha^{-1} (16.03 t). However, it was on par with N_2P_2 which registered the fruit yield $plant^{-1}$ (1.19 kg) and fruit yield ha^{-1} (15.71 t). The maximum net returns and returns per Rupee invested were recorded with the application of N_2P_2 which was followed by N_3P_2.

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INTRODUCTION

India has a wide range of climate and soils on which a large number of vegetable crops are grown. The nutritive values of vegetables are having great impact on our diet. They are excellent sources of proteins, vitamins, carbohydrates and minerals like calcium and iron. Also, they have noteworthy medicinal values which are used in some traditional medicines. India is producing 93.92 million tonnes of vegetables from 624.5 million hectares enabling to secure second rank in the world next to China (Brij Bala and Sharma, 2006). It was noted that the rice based cropping system has assumed higher importance to meet the dietary habits of 42 per cent population of India (Nanda *et al*., 1999). It was evaluated under different physiographic situations (uplands, midlands and irrigated conditions) in farmer's field. The following crops like tomato, chilli, okra, cowpea, mung bean, pigeon pea, cucumber and sweet potato and other cucurbits were cultivated under rice fallow condition (Jha and Singh, 1993). In the districts of Cauvery delta region, rice is grown extensively in monocropping. In Kharif season, the pulse (mung bean) is grown in relay cropping with rice.

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After the harvest of the rice and pulse, many farmers leave their lands fallow, though there is some irrigation facilities available. This restriction of cultivation is mainly due to the non-availability of suitable cost effective technologies for the cultivation of cash crops like vegetables in rice fallow land and lack of farmers awareness on alternate crops. Though some farmers are growing rice fallow vegetables such as bitter gourd ecotype 'mithipagal', they are not adopting appropriate technologies for the effective cultivation.. This situation leads unemployment, poverty and malnutrition among the small and marginal farmers and landless agricultural labours. Hence, it is an imperative need to find out suitable technologies for reducing the cost of field preparation and for the effective utilization of vegetables such as bitter gourd in the fallow land. Bitter gourd is one of the most popular vegetable in South East Asia. It is a member of the cucurbitaceae family along with cucumber, watermelon, snake gourd and musk melon. Nowadays, they are having an excellent yield potential under the rice fallow of cauvery delta region in Tamilnadu, India. Depending on location, bitter gourd is also known as bitter melon, Karella or balsam pear. Apart from the small fruits which is called as 'mithipagal' and it is cultivated in all districts of Tamilnadu, India. The nutritional value of fruits of bitter gourd is similar when compared to other cucurbits with the notable exception that it is much higher in folate and vitamin - C and the vine tips are an excellent source of vitamin-A. The medicinal value of the bitter gourd in the treatment of infectious diseases and diabetes is attracting the attention of researchers worldwide. The leaf extract of bitter gourd is also having a very good mosquitocidal effect (Muralee Yadav *et al*., 2008). Although, there was enough study on the inorganic nutrition, of common bitter gourd, ecotype 'mithipagal' is in need to standardize the optimum dose of nitrogen and phosphorus due to its habitat which differed from the normal bitter gourd crop.

MATERIALS AND METHODS

The investigation was carried out in the Experimental Farm, Department of Horticulture, Faculty of Agriculture, Annamalai University, Annamalainagar which is geographically situated at $11^0 24'$ North latitude and $79^0 44'$ East longitude at an altitude of ±5.97 m above mean sea level in Cuddalore district of Tamilnadu, India. Bitter gourd (*Momordica charantia* L.) ecotype 'mithipagal' of cucurbitaceae family is a monoecieous, ground creeping and spreading type vine plant which grow to an average length of 1.5-2.0 m. It has small serrated leaves and produces yellow coloured flowers. The average ratio of male and female flower is 1:15. The flowers of bitter gourd are first developed 30 to 40 days after sowing and vine will bloom for about four months. Each flower open at sunrise and remain viable for only one day. It produces 30-35 fruits per vine. The fruits are small in size (2.5-3.5 cm) with dark to light green coloured and weight about 25-30 grams. The average yield potential is 4-6 t ha^{-1} under the rice fallow condition. It is extensively grown in Tamilnadu especially in Villupuram and Cuddalore districts. The flesh is red in colour during ripening and it has 5 to 6 seeds per fruit. Seeds are soft and light coloured. To avoid over ripening of the fruits, frequent (once in 3-4 days) harvest is necessary. The seeds used in the investigation were procured from the local farmers of the Chidambaram area.

Experiment details

Design	:	FRBD (Factorial Randomized Block Design)
Treatments	:	12
Replications	:	4
Spacing	:	100 x 75 cm

Treatment details

T_1	-	N_0P_0	-	0:0 kg ha^{-1}
T_2	-	N_0P_1	-	0:15kg ha^{-1}
T_3	-	N_0P_2	-	0:30 kg ha^{-1}
T_4	-	N_1P_0	-	30:0 kg ha^{-1}
T_5	-	N_1P_1	-	30:15 kg ha^{-1}
T_6	-	N_1P_2	-	30:30 kg ha^{-1}
T_7	-	N_2P_0	-	60:0 kg ha^{-1}
T_8	-	N_2P_1	-	60:15 kg ha^{-1}
T_9	-	N_2P_2	-	60:30 kg ha^{-1}
T_{10}	-	N_3P_0	-	90:0 kg ha^{-1}
T_{11}	-	N_3P_1	-	90:15 kg ha^{-1}
T_{12}	-	N_3P_2	-	90:30 kg ha^{-1}

The experiment was conducted in the rice fallow land of the Experimental Farm, Department of Horticulture, Faculty of Agriculture, Annamalai University. The experimental field was divided into plots of 20.0 m x 12.5 m dimension. Pits were formed with size of 30 cm^3 with a spacing of 100 x 75 cm which was selected as a best one from the first experiment and four seeds pit^{-1} were sown. The field was well prepared with conservation (minimum) tillage. The treatments were randomly arranged in each replication. Inorganic fertilizers (graded levels) were applied plot wise as per the treatment schedule. The half of N and entire P along with constant dose of potassium (30 kg ha^{-1}) were applied as basal. The remaining N was top dressed in two splits on 30 and 45 DAS. The control was maintained with no fertilizers. The regular cultural practices were adopted uniformly for all the experimental plots as in the experiment. Biometric observations such as growth and yield characters were recorded at different stages of crop growth from ten plants selected at random in each treatment of the replications. The experimental data were analysed statistically as per the procedure described by Panse and Sukhatme (1978) and wherever the results were found to be significant, the critical differences were arrived at five per cent level to draw statistical conclusions.

RESULTS AND DISCUSSION

The results of the experiment on the influence of graded levels of nitrogen, phosphorus and their interactions on growth and yield of bitter gourd ecotype 'mithipagal' under rice fallow condition are discussed in this chapter under the following headings.

1. Individual effects of nitrogen
2. Individual effects of phosphorus and
3. Interaction effect of nitrogen and phosphorus

Individual effects of nitrogen: The significant variation due to Per se effect of nitrogen on certain growth characters like vine length, number of branches and number of leaves in bitter gourd at 60 DAS and final harvest were observed. The vine length was increased as the levels of 'N' increased and as well as growth stages of plant. Significantly the highest vine length was observed in application of 80 kg N ha^{-1} (N_3). The lowest vine length was observed in the control at both stages of crop growth. The increased trend of growth may be due to higher N application and the increased number of leaves which trap radiant energy from sunlight for photosynthesis and utilized for build up of new cells by increased cell elongation leading to higher internodal length which could have ultimately increased the vine length. Further increased net assimilation rate is a supplement to the increased vine length. It was in conformity with the results of Patil *et al.* (1996) who reported that the vine length increased significantly with increasing levels of nitrogen (100 kg ha^{-1}) in bottle gourd. Also it was supported by Prasanna Kumar *et al*. (2004) in ridge gourd. Similarly, number of branches and leaves $plant^{-1}$ were also significantly higher with the application of 80 kg N ha^{-1} (N_3) and it was on par with N_2 (60 kg N ha^{-1}) against the control (N_0). The linear trend in the above growth and physiological characters might be due to the increased absorption of N through enough availability and ultimately increases the chlorophyll content in leaves which helped more synthesis of carbohydrates and encourages the growth and physiological characters. These findings are in consonance with the reports of Law-Ogbomo *et al*. (2008) in tomato who reported that increasing rate of fertilizer application results in increased LAI which favoured better utilization of solar radiation by the way it enhances the rate of photosynthesis. Also, it was supported by Suresh and Papaiah (1991) in bitter gourd and Soni *et al*. (2006) in bhendi. The results in respect of number fruits $plant^{-1}$ increased significantly as the levels of N increased. The highest number of fruits $plant^{-1}$ (37.67) was recorded in N_3 and that was on par with N_2 (36.80). The increased trend in number of fruits plant^{-1} might be attributed due to the absorption of more nutrients by plants by the higher dose of N which in turn enhances the number of branches and node numbers. Since the cucurbitaceous vegetables are producing more number of female flowers in the secondary branches, the increased number of branches plant^{-1} directly affects the number of female flowers and fruits plant^{-1}. It was concurrence with the findings of Parikh and Chandra (1969) in cucumber, who envisaged the enhancement of yield attributes in their respective crops due to the enhancement in applied nitrogen level. Also it was supported by Prasanna Kumar *et al.* (2004) in ridge gourd. There was significant increase in fruit weight by the increased application of nitrogen. The level N_3 (80 kg ha^{-1}) and N_2 (60 kg ha^{-1}) recorded the highest fruit weight (27.70 and 29.01g). This might be due to the application of higher dose of nitrogen levels in N_3 and N_2 which accelerated the source-sink relationship and leads to enhancement of fruit weight. The findings are in line with the results of Singh and Chonkar (1996) who reported that increased dose of nitrogen (60 kg ha^{-1}) fertilization showed significant increase in fruit weight in musk melon. Similar results were reported by Singh (2000) in tomato. The yield increased linearly as the level of N increased. Significantly the highest fruit yield plant^{-1} (1.12 and 1.08 kg) and yield ha^{-1} (14.76 and 14.13 t) were observed in N_3 and N_2 levels respectively. Increased yield may be attributed to the application of increased nitrogen that enhances the number of branches plant^{-1}, number of female flowers plant^{-1} and fruit weight which favoured the increasing yield plant^{-1} and hectare^{-1}. Similar increase in yield due to the increased dose of N (0-100 kg ha^{-1}) application had also been registered in bottle gourd (Patil *et al.*, 1996).

respiration process and also contributes to the synthesis of carbohydrates, fats and proteins. Patil *et al.* (1996) also reported that the vine length increased significantly with increasing levels of phosphorus upto 60 kg ha^{-1} in bottle gourd. Similarly, the highest number of branches and leaves plant^{-1} at 60 DAS and at final harvest respectively were observed with the application of P_2 (30 kg ha^{-1}). Significantly the lowest number of branches and leaves plant^{-1} at both stages were observed in control. The increased number of branches and leaves plant^{-1} may be due to synthesis of carbohydrates, fats and proteins by the appropriate level of phosphorus and that might have utilized for building up of new cells in the plants and enhances the growth attributes as reported by Tewari and Singh (2000) in french bean. Also, it was supported by the results of Prasanna Kumar *et al.* (2004) in ridge gourd who observed that the number of branches plant^{-1} was significantly increased up to 60 kg ha^{-1} of phosphorus application. The yield parameters like number of fruits plant^{-1} fruit weght and fruit yied ha^{-1}and were significantly higher with the P_2 level of phosphorus application (30 kg ha^{-1}) and the minimum was observed in P_0.The increasing trend of the above yield parameters due to the application of P_2 (30 kg ha^{-1}) could be attributed due to its important role in rapid cell division and cell elongation which enhances the production of more number of female flowers and fruits plant^{-1}. Further, its role in photosynthesis, energy storage, cell division and enlargement contributed to the increased biomass production and productive source component which is an attributing factor for source-sink relationship (Prasanna Kumar *et al.*, 2004). It was in conformity with the reports of Das *et al.* (2005) in Vegetable pea who evinced increment in yield attributes due to higher levels of phosphorus application.

Table 1. Influence of graded levels of N, P and their interactions on vine length (cm) and number of primary branches plant^{-1} of bitter gourd ecotype 'mithipagal' under rice fallow condition

	Vine length (cm) at final harvest				Number of primary branches plant^{-1} at final harvest			
Phosphorus Nitrogen	P_0	P_1	P_2	N-Mean	P_0	P_1	P_2	N-Mean
N_0	198.12	202.36	207.44	202.64	8.56	9.49	10.51	9.52
N_1	205.97	211.02	214.63	210.54	10.19	11.22	11.89	11.10
N_2	216.36	223.46	230.56	223.64	12.28	13.65	15.05	13.60
N_3	219.93	227.01	232.32	226.42	12.96	14.36	15.23	14.18
P-Mean	210.095	215.96	221.23	215.81	10.99	12.18	13.17	12.10

	N	P	N X P
SED	2.59	2.47	3.03
CD (p = 0.05)	5.23	4.96	NS

	N	P	N X P
SED	0.62	0.45	1.06
CD (p = 0.05)	1.26	0.92	NS

Individual effect of phosphorus: Perusal of results on the *Per se* effects of phosphorus (P_2O_5) showed that ranking of treatments followed the descending order of phosphorus levels (P_2, P_1 and P_0). This suggests that the response of growth parameters were linear to the increment of phosphorus levels. Corroborative results of linear trend of response in growth parameters like plant height, leaf area index and biomass yield due to the enhancement of phosphorus levels in various crops were put forth by Spirescu (1986) in water melon and Arora and Satish Siyag (1989) in sponge gourd. Phosphorus being a basic mineral associated with the synthesis of protoplasm, aminoacids, proteins and nucleic acid which play a greater biological role in plants, thus resulted in an improvement of growth characters. Significantly the highest vine length at 60 DAS and final harvest (59.62 and 221.23 cm) respectively, were observed in application of P_2 (30 kg ha^{-1}) against the control (P_0). This increase in vine length might be due to the increased application of phosphorus which plays a vital role in

Interaction effect of nitrogen and phosphorus: The significance of variance due to interaction effects of nitrogen and phosphorus for fruits plant^{-1}, fruit weight, fruit yield plant^{-1} and yield ha^{-1} showed the response of one factor varies with the level of other factor. Hence, fixing the optimum dose of nitrogen and phosphorus based on their main effects alone would not be advisable. Since yield is the ultimate aim for any crop production research work, this was used as criteria for selecting the best treatment combination. Among the twelve treatment combinations, N_3P_2, N_2P_2 and N_3P_1 were observed to be the top three combinations. Significantly the maximum number of number of fruits plant^{-1} (9.46), fruit weight (31.15), fruit yield plant^{-1} (1.21 kg) and yield ha^{-1} (16.3 t) were found with the application of N_3P_2 combination. However, these values were on par with the next combination treatment of N_2P_2. This might be due to the increased dry matter production which accelerates the yield attributes. Corroborative results were put forth by Deswal and Patil (1984) in water melon and Ramachander *et al.* (1987) in muskmelon who envisaged the influence of interaction between N and P in increasing the dry matter production and yield parameters of ridge gourd and opined that the increment in yield parameters due to interaction of N and P might be attributed by the complimentary effect of one over other in the interaction.

Table 2. Influence of graded levels of N, P and their interactions on number of leaves plant^{-1} of bitter gourd ecotype 'mithipagal' under rice fallow condition

	Number of leaves plant^{-1} at final harvest			
Phosphorus Nitrogen	P_0	P_1	P_2	N-Mean
N_0	306.17	320.19	341.22	322.52
N_1	334.62	353.58	367.93	352.04
N_2	375.16	401.71	428.26	401.71
N_3	388.14	414.57	436.15	412.95
P-Mean	351.02	372.50	393.39	372.30

	N	P	N X P
SED	10.73	9.67	12.67
CD (p = 0.05)	21.48	19.37	NS

Table 3. Influence of graded levels of N, P and their interactions on number of fruits plant^{-1} of bitter gourd ecotype 'mithipagal' under rice fallow condition

	Number of fruits plant^{-1}			
Phosphorus Nitrogen	P_0	P_1	P_2	N-Mean
N_0	29.09	30.26	31.98	30.43
N_1	31.51	33.05	34.19	32.91
N_2	34.65	36.82	38.93	36.80
N_3	35.69	37.88	39.46	37.67
P-Mean	32.73	34.50	36.14	34.45

	N	P	N X P
SED	0.46	0.41	0.51
CD (p = 0.05)	0.95	0.83	1.02

Table 4. Influence of graded levels of N, P and their interactions on fruit weight (g fruit^{-1}) of bitter gourd ecotype 'mithipagal' under rice fallow condition

	Fruit weight (g fruit^{-1})			
Phosphorus Nitrogen	P_0	P_1	P_2	N-Mean
N_0	22.93	23.82	25.09	23.94
N_1	24.77	25.98	26.86	25.87
N_2	27.25	29.01	30.74	29.01
N_3	28.09	29.88	31.15	29.70
P-Mean	25.76	27.17	28.46	27.13

	N	P	N X P
SED	0.36	0.31	0.41
CD (p = 0.05)	0.71	0.63	0.82

Table 5. Influence of graded levels of N, P and their interactions on fruit yield plant^{-1} (kg) of bitter gourd ecotype 'mithipagal' under rice fallow condition

	Fruit yield plant^{-1} (kg)			
Phosphorus Nitrogen	P_0	P_1	P_2	N-Mean
N_0	0.65	0.72	0.83	0.73
N_1	0.81	0.89	0.96	0.88
N_2	0.98	1.09	1.19	1.08
N_3	1.03	1.14	1.21	1.12
P-Mean	0.86	0.96	1.04	0.95

	N	P	N X P
SED	0.02	0.01	0.03
CD (p = 0.05)	0.04	0.02	0.05

Hence, it could be concluded that the higher yield obtained in combinations may be due to the complement type interactions in which one factor compensate the deficiency of other factor. The results clearly showed that the higher yield was obtained mainly due to increased dry matter production, number of fruit plant^{-1} and fruit weight.

Table 6. Influence of graded levels of N, P and their interactions on fruit yield ha^{-1} (t) of bitter gourd ecotype 'mithipagal' under rice fallow condition

	Fruit yield ha^{-1} (t)			
Phosphorus Nitrogen	P_0	P_1	P_2	N-Mean
N_0	8.67	9.48	10.59	9.58
N_1	10.37	11.36	12.19	11.30
N_2	12.55	14.15	15.71	14.13
N_3	13.36	14.91	16.03	14.76
P-Mean	11.23	12.47	13.63	12.44

	N	P	N X P
SED	0.33	0.29	0.35
CD (p = 0.05)	0.68	0.62	0.71

REFERENCES

Arora, S.K. and Satish Siyag. 1989. Effect of nitrogen (N) and phosphorus (P) on growth, flowering and sex expression of sponge gourd. Haryana *J. Hort. Sci.,* 18(1-2): 106-112.

Deswal, I.S. and V.K.Patil. 1984. Effect of N, P and K on the fruit yield of water melon. *J. Maharashtra. Agric. Univ.,* 9(3): 308-309.

Jha, K.P. and Y.V. Singh. 1993. Rice based cropping systems for humid tropics. Andaman Science Assocaition, Central Agricultural Research Institute. *J. Agron.,* 4(1): 69-80.

Law-Ogbomo, K.E. and R.K.A. Egharevba. 2008. Effects of planting density and NPK fertilization on growth and fruit yield of tomato (*Lycopersicon esculentum* Mill.). Res J. Agri and Biol. Sci., 4(3): 265-272.

Muralee Yadav, Rashmi Chaudhary and D.B. Singh, 2008. Combining ability in bitter gourd. Indian J. Hort., 65 (2):163-166.

Nanda, S.S.,G.K. Patro, M.A. Aim and N. Mohanda. 1999. Efficiency of rice-based crop sequence under coastal eco-system. Indian J. Agron., 44(3): 452-455.

Panse, V.G. and P.V. Sukhatme. 1978. Statistical methods of agricultural workers. ICAR Publications, New Delhi, pp.225.

Patil, S.R., U.T. Desai, B.G. Pawar and B.T.Patil. 1996. Effect of NPK doses on growth and yield of bottle gourd cv. Samrat. J. Maharashtra. Agric. Univ., 21(1): 65-67.

Prasanna Kumar, S.C., K.S. Krishnappa, N. Shiva Reddy and A. Anianappa. 2004. Effect of varying levels of NPK on growth and yield of ridge gourd in Southern dry region of Karnataka. Mysore J. Agric. Sci., 38(4): 446-453.

Ramachander, P.R., B.S. Prabakar, Vishnu Shukla and K.Srinivas. 1987. Optimum fertilization for musk melon using computer stimulation model. Indian J. Hort., 44(1-2): 133-138.

Singh, D.N and V.S.Chonkar. 1996. Effect of nitrogen, phosphorus, potassium and spacing on growth and yield of musk melon (*Cucumis melo* L.). *Indian J. Hort.,* 24: 265-269.

Singh, R.V. 2000. Response of French bean (*Phaesolus vulgaris* L.) to plant spacing, nitrogen and phosphorus fertilization. *Indian J. Hort.,* 57(4): 338-342.

Soni, N., S.G Bharad., V.S. Gonge, D.R. Nandre and S.M. Ghawade. 2006. Effect of spacing and nitrogen levels on growth and seed yield of okra. *Internat J. Agric. Sci.,* 2(2): 444-446.

Spirescu, C. 1986. Chemical fertilization of watermelon cultivated on sand in southern Romanica. Bulethinal informative al Academiei de stiinte Agricle Si ssilvice, No.16:115-126.

Suresh, J. and C.M. Papaiah. 1991. Growth and yield of bitter gourd as influenced by nitrogen, phosphorus and maleic hydrazide. *South Indian Hort.,* 39(5): 289-291.

Tewari, J.K and S.S. Singh. 2000. Effect of nitrogen and phosphorus on growth and seed yield of French bean (*Phaseolus vulgaris* L.). *Veg. Sci.,* 27(2): 172-175.

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