AJH
eISSN- 0976-724X

THE ASIAN JOURNAL OF HORTICULTURE
Volume **10** | Issue 2 | December, 2015 | 207-211
Visit us -*www.researchjournal.co.in*

RESEARCH PAPER

DOI : 10.15740/HAS/TAJH/10.2/207-211

Article history :
Received : 22.06.2015
Revised : 21.10.2015
Accepted : 07.11.2015

Effect of phosphorus and potassium on growth and yield characters of bitter gourd (*Momordica charantia* L.) ecotype 'Mithipagal'

■ **JOHNSON NAOREM AND R. SURESHKUMAR[1]**

Members of the Research Forum

Associated Authors:
[1]Department of Horticulture Science, Faculty of Agriculture, Annamalai University, CHIDAMBARAM (T.N.) INDIA

Author for correspondence :
JOHNSON NAOREM
Department of Horticulture Science, Faculty of Agriculture, Annamalai University, CHIDAMBARAM (T.N.) INDIA

ABSTRACT : An experiment on effect of phosphorus and potassium on growth and yield characters of bitter gourd ecotype 'Mithipagal' was carried out with the four levels of phosphorus (0, 30, 60 and 90 kg ha^{-1}) and three levels of potassium(0, 40 and 80 kg ha^{-1}) comprised of twelve treatment combinations under Factorial Randomized Block Design with three replications. Nitrogen @90 kg ha^{-1} was applied in all treatments as constant dose except the control. Among the graded levels, P_3K_2 (Phosphorus 90 kg ha^{-1}+ Potassium 80 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 P_2K_2. The maximum values of physiological characters were found with the treatment combination of P_3K_2, which registered the maximum leaf area index, total chlorophyll content, photosynthetic rate and dry matter production.

KEY WORDS : Bitter gourd, *Momordica charantia*, Growth, Yield

HOW TO CITE THIS ARTICLE : Naorem, Johnson and Sureshkumar, R. (2015). Effect of phosphorus and potassium on growth and yield characters of bitter gourd (*Momordica charantia* L.) ecotype 'Mithipagal'. *Asian J. Hort.*, **10**(2) : 207-211.

Bitter gourd (*Momordica charantia* L.) is one of the most popularly grown warm season vegetable crops in South East Asia. It is a member of the Cucurbitaceae family along with cucumber, watermelon, snake gourd and musk melon. India is producing 93.92 million tones of vegetables from 624.5 million hectares enabling to secure second rank in the world next to China (Brij Bala and Sharma, 2006). 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 almost parts of the India including Tamil Nadu. It is a trailing climber annual, which branches freely, and semi angled monoecious crop duration of 100-120days. The importance of bitter gourd has been long recognized due to its high nutritive value and medicinal properties. 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. The leaf extract of bitter gourd is also having a very good Mosquitocidal effect (Yadav *et al.*, 2008). According to the dieticians, an individual should consume about 215 grams each of leafy and other vegetables and 70 grams of root vegetables for our balanced diet of a routine day. But it is too below (140 g day^{-1}) against to this per capita recommendation of the vegetables (Mathura Rai and Pandey, 2004). Bitter gourd is also widely grown in Tamil Nadu with an area of over 1,074 hectares with an annual production of 12.8 thousand tones. The average production is 10-15 tons per hectare under normal management practices.

It is monoecious and is available with range of male

and female sex ratio. It exhibits different constraints in increasing the production, out of this sex expression is also one of the most important one. The family is characterized by various forms of sex expression varying from strict gynoecious to hermaphrodite as well as monoecious is the most common one. Earlier different efforts have been made to attain change in sex expression through genetically, environmental and nutritional manipulation. However the use of different inorganic fertilizers at recommended doses becomes important tools in the particular respect. The right combination of inorganic fertilizers at the recommended doses not only alters the sex ratio in cucurbits but also increases the yield to a significant level (Karuppaiah and Kathiravan, 2006). Of all the above factors, nutrient management forms the essential requirement for establishment of any crop (Surendra Singh *et al.*, 2005). Therefore present investigation was carried out to study the effect of inorganic nutrients at the adequate quantity on growth and yield characters of bitter gourd type "Mithipagal".

RESEARCH METHODS

The experiment "effect of phosphorus and potassium on growth and yield characters of bitter gourd (*Momordica charantia* L.) ecotype 'Mithipagal' was carried out in the Department of Horticulture, Faculty of Agriculture, Annamalai University, Annamalainagar, Tamil Nadu, India during 2012-2014. The experiment was carried out with the four levels of phosphorus (0, 30, 60 and 90 kg ha^{-1}) and three levels of potassium (0, 40 and 80 kg ha^{-1}) comprised of twelve treatment combinations under Factorial Randomized Block Design with three replications. Nitrogen @ 90 kg ha^{-1} was applied in all treatments as constant dose except the control. Seeds are sown in pits with a spacing of 100 x 75cm. One third of nitrogen and full doses of phosphorus and potassium were applied as basal dose as per the treatment. The remaining doses of Nitrogen were applied on 30 and 45 days after sowing. The data were statistically analyzed using the method suggested by Panse and Sukhatme (1987).

RESEARCH FINDINGS AND DISCUSSION

The findings of the present study as well as relevant discussion have been presented under following heads :

Individual effect of phosphorus :

The results revealed that the treatment varied significantly for the growth and yield character studied. The 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 Hassan *et al.* (1984) in pickling melon, Spirescu (1986) in water melon and Arora and Satish (1989) in sponge gourd. Phosphorus being a basic mineral associated with the synthesis of protoplasm, amino acids, 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 (60.37 and 222.14 cm), respectively, were observed in application of P_3 (90 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 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 up to 60 kg ha^{-1} in bottle gourd. It was in conformity with the results of Das *et al.* (2005) in vegetable pea. Similarly, the highest number of branches and leaves $plant^{-1}$ at 60 DAS and at final harvest, respectively were observed with the application

Table 1 : Individual effect of phosphorus on growth and yield of bitter gourd

Characters	Vine length(cm)		Primary branches $plant^{-1}$		Number of leaves $plant^{-1}$		Leaf area index	Total chlorophyll content (mg g^{-1})	Photosynthetic rate (μ mol CO_2 $m^{-2}s^{-1}$)	Dry matter production (g $plant^{-1}$)
	At 60 days	At final harvest	At 60 days	At final harvest	At 60 days	At final harvest				
Treatments										
P_0	50.37	198.34	3.25	8.24	116.13	310.18	0.94	0.156	6.69	112.98
P_1	53.80	206.24	3.48	9.82	144.43	339.70	1.08	0.215	7.81	126.5
P_2	59.13	219.16	3.74	12.38	183.96	389.49	1.31	0.335	9.63	150.48
P_3	60.37	222.14	3.80	12.90	193.04	400.61	1.34	0.358	10.04	156.01
S.E.±	1.21	2.59	0.06	0.62	9.59	10.73	0.04	0.027	0.52	2.78
C.D. (P = 0.05)	2.45	5.23	0.11	1.26	19.21	21.48	0.09	0.056	1.03	5.59

of P_3 (90 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 Umamaheswarappa *et al.* (2006) in bottle gourd and 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. Significantly the highest dry matter production was observed in plants (156.01g plant^{-1}) which received the phosphorus level P_3 (90 kg ha^{-1}) when compared to control (P_0) The increased dry weight of plant may be due to the increased vine length, number of branches and leaves plant^{-1}. The results are in line with the reports of Kumar *et al.* (2004) in ridge gourd and Souad *et al.* (1992) in bitter gourd (Table 1).

Individual effect of potassium :

A significant variation due to *per se* effect of potassium on vine length, number of branches, leaves plant^{-1}, leaf area index, and total chlorophyll content, photosynthetic rate and dry matter production were observed in bitter gourd. Vine length was increased as the level of potassium increased as well as growth stages of plant. Significantly the highest vine length was observed in application of 58.27 kg of potassium ha^{-1} K_2. The lowest vine length was observed in control at both stages (60 DAS and at final harvest) of crop growth. The increasing trend of growth may be due to higher

Table 2 : Individual effect of potassium on growth and yield of bitter gourd

Characters	Vine length (cm)		Primary branches plant^{-1}		Number of leaves plant^{-1}		Leaf area index	Total chlorophyll content (mg g^{-1})	Photosynthetic rate (µ mol CO_2 m^{-2}s^{-1})	Dry matter production (g plant^{-1})
	At 60 days	At final harvest	At 60 days	At final harvest	At 60 days	At final harvest				
Treatments										
K_0	53.45	205.79	3.42	9.71	141.52	338.68	1.08	0.219	7.74	126.54
K_1	56.03	211.66	4.59	10.91	159.27	360.26	1.16	0.266	8.56	136.65
K_2	58.27	216.95	3.70	11.89	177.38	381.05	1.25	0.315	9.33	146.31
S.E.±	1.09	2.47	0.04	0.45	8.32	9.67	0.03	0.024	0.42	2.47
C.D. (P = 0.05)	2.21	4.96	0.08	0.92	16.64	19.37	0.06	NS	NS	4.93

N.S.=Non-significant

Table 3 : Interaction effect of potassium and phosphorus on the growth and yield of bitter gourd

Characters	Vine length(cm)		Primary branches plant^{-1}		Number of leaves plant^{-1}		Leaf area index	Total chlorophyll content (mg g^{-1})	Photosynthetic rate (µ mol CO_2 m^{-2}s^{-1})	Dry matter production (g plant^{-1})
	At 60 days	At final harvest	At 60 days	At final harvest	At 60 days	At final harvest				
Treatments										
T_1 .P_0K_0(0:0 kg ha^{-1})	48.38	193.82	3.05	7.28	101.21	293.83	0.87	0.124	6.06	105.69
T_2- P_0K_1(0:40kg ha^{-1})	50.33	198.06	3.31	8.21	111.97	307.85	0.93	0.151	6.57	111.87
T_3 .P_0K_2(0:80 kg ha^{-1})	52.40	203.14	3.42	9.23	135.23	328.88	1.02	0.194	7.45	121.38
T_4- P_1K_0(30:00 kg ha^{-1})	51.91	201.67	3.39	8.91	130.02	322.28	0.99	0.178	7.09	118.14
T_5- P_1K_1(30:40 kg ha^{-1})	53.96	206.72	3.51	9.94	146.19	341.24	1.11	0.221	7.93	127.56
T_6 .P_1K_2(30:80 kg ha^{-1})	55.53	210.33	3.57	10.61	157.08	355.59	1.17	0.248	8.42	133.81
T_7- P_2K_0(60:0 kg ha^{-1})	55.99	212.06	3.59	11.01	161.71	362.82	1.20	0.274	8.66	138.07
T_8- P_2K_1(60:40 kg ha^{-1})	59.13	219.16	3.75	12.37	184.18	389.73	1.31	0.333	9.64	150.49
T_9- P_2K_2(60:80 kg ha^{-1})	62.27	226.26	3.91	13.77	205.99	415.92	1.41	0.401	10.61	162.89
T_{10} P_3K_0(90:0 kg ha^{-1})	57.54	215.63	3.67	11.68	173.16	375.81	1.26	0.302	9.17	144.26
T_{11}- P_3K_1(90: 40 kg ha^{-1})	60.71	222.71	3.82	13.08	194.76	402.23	1.34	0.362	10.13	156.68
T_{12}- P_3K_2(90:0 kg ha^{-1})	62.88	228.08	3.93	13.95	211.22	423.81	1.42	0.412	10.84	167.11
S.E.±	1.53	3.03	0.09	1.06	11.13	12.17	0.08	0.036	0.73	3.05
C.D. (P=0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS	6.12

NS=Non-significant

potassium application which improves the utilization of N which increases the number of leaves of trapping the radiant heat or energy from the sunlight for photosynthesis and utilization for building up of new cells by the developing cell elongation leading to higher internodal length which could have ultimately increases the vine length. It was in confirmatory with the results of Kanaujia *et al.* (1998) who reported that vine length increases significantly with the increasing levels of potassium, which is also reported by Cutcliffe and Munro (1980). Dry matter production of plant at final harvest was significantly the highest (167.11 g plant^{-1}) in K_2 and it was on par with K_1. The minimum dry matter production was recorded in K_0 (control). The increased dry matter production of plant may be attributed due to the increasing vine length, number of branches and leaves plant^{-1}. These results are in line with the findings of Okonwu and Mensah (2012) in pumpkin who observed that the increase levels of potassium encourage the translocation of carbohydrates and cell divisions of the plant which enhances the dry matter production. Similar results were observed by Bidari and Hebsur (2011) in vegetable crops (Table 2).

Interaction effect of phosphorus and potassium :

The significance of variance due to interaction effects of phosphorus and potassium for vine length at 60 DAS and final harvest (62.88 and 228.08 cm), respectively, were observed in application of P_3K_2 against the control (P_0). Similarly, the highest number of branches (3.80 and 13.95), leaves plant^{-1} (211.22and 423.81), leaf area index (1.42), total chlorophyll content (0.412 mg g^{-1}), photosynthetic rate (10.84 CO_2 $m^{-2}s^{-1}$) and dry matter production (167.11g^{-1}) were observed with the application of P_3K_2 showed the response of one factor varies with the level of other factor. Hence, fixing the optimum dose of phosphorus and potassium 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. Significantly the lowest number of branches and leaves plant^{-1} were observed in control. Among the twelve treatment combinations, P_3K_2, P_2K_2 and P_3K_1 were observed to be the top three combinations. Significantly, higher dry matter production of plant was observed with the combined application of P_3K_2 (167.1 kg ha^{-1}). It was on par with P_2K_2 (162.89 g). The highest dry matter production might be due to the increased nutrient availability and assimilation by plants. This is in confirmation with Kanaujia *et al.* (1998) and Cutcliffe and Munro (1980) in peas who observed that increase in growth parameters due to the interaction of P and K might be attributed by the supplementary influence of *Per se* effect of these nutrients contributing to the enhanced output in interaction (Table 3). Hence, it could be concluded that though the nutrient combination of $P_{90}K_{80}$ had recorded the highest yield ha^{-1}(15.01 t), while considering economics, application of $P_{60}K_{80}$ along with 90 kg N is the optimum dose for the economic feasibility and could be recommended for the better yield of bitter gourd (*Momordica charantia* L.) ecotype 'mithipagal'.

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.

Bidari, B.I. and Hebsur, N.S. (2011). Potassium in relation to yield and quality of selected vegetable crops. *Karnataka J. Agric. Sci.*, **24**(1) : 55-59.

Brij Bala and Sharma, S.P. (2006). Production trends and marketing of vegetables to fetch dollars. *Science Tech. Entrepreneur.*, Nov. pp.5-10.

Kanaujia, S.P., Sharma, S.K. and Rastogi, K.B. (1998). Effect of phosphorus, potassium and Rhizobium inoculation on growth and yield of pea (*Pisum sativum* L.). *Ann. Agric. Res.*, **19** : 219-221.

Karuppaiah, P. and Kathiravan, J. (2006). Effect of fertilizers on the performance of cucumber (*Cucumis sativus* L.) under rice fallow condition. *Plant Archives*, **6**(2) : 573-576.

Kumar, S.C. Prasanna, Krishnappa, K.S., Shiva Reddy, N. and Anianappa, A. (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.

Mathura Rai and Pandey, A.K. (2004). Meeting global trade. *Survey of Indian Agric.*, pp. 129-131.

Okonwu, K. and Mensah, S.I. (2012). Effects of NPK (15: 15: 15) fertilizer on some growth indices of pumpkin. *Asian J. Agric. Res.*, **6**(3) : 137-143.

Panse,V.G and Sukhatme, P.V. (1987). *Statistical methods for agricultural workers*. ICAR Publications, New Delhi. pp. 225.

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

Souad, EL-G., Hendawy, S. and Kamel, A. (1992). Effect of nitrogen and potassium fertilization on the yield and quality of *Momordica charantia* L. fruits. *Kerba Polonica*, **53**(1):11-19.

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.

Singh, Surendra, Sharda, Vaishali, Sharda, Ajay and Bector, Vishal (2005). Water conservation through tillage. *J. Res. Punjab Agric. Univ.*, **42**(4): 479-485.

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

Umamaheswarappa, P., Nache Gowda, V., Venkatesha Murthy, P. and Krishnappa, K.S. (2006). Growth, yield and quality of cucumber (*Cucumis sativus* L.) as influenced by varying levels of nitrogen, phosphorus and potassium. *Karnataka J. Hort.*, **1**(4): 71-77.

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