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Momordica charantia L. bitter gourd response to different phosphorus doses and sowing dates

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The current paper aims to improve the quality and yields of bitter gourd by addition of different phosphorus doses and sowing dates. An Experiment was conducted on the response of *Momordica charantia* L. bitter gourd to different phosphorus does and sowing dates on the growth, yields. Four different level of treatment 0 kg ha^{-1},40 kg ha^{-1}, 70 kg ha^{-1}, 100 kg ha^{-1}), comprised by 12 replicated treatment under Randomized complete block designed (RCBD). The results conclude that Phosphorus level 70 kg ha^{-1} shows significantly best results, followed by 100 kg ha-1 phosphorus treatment, while the rest levels showed moderate results. The sowing dates 10 March shows the best sowing dates for bitter gourd cultivation and the Phosphorus levels should be 70 kg ha-1 or between 70kg ha^{-1} and 100kg ha^{-1}, will be fallowed on the quality of the soil.

Keywords: *Momordica charantia* L, Bitter Gourd, Phosphorus Doses, Sowing Dates

INTRODUCTION

Momordica charantia L bitter gourd is a vegetable species having a climbing habit and belong to family Cucurbitaceae (Grover and Yadav 2004, Leung, Birtwhistle et al. 2009, Joseph and Jini 2013; Naz et al. 2019). Distinctive cultivars are diverse in the shape and intensity. It is utilized in cooking in the green or early yellowing stages. The youthful shoots and leaves of the severe gourd may likewise be eaten as greens. Chinese like Bitter gourd because of its severe flavor utilized in cooking as mix fries, soup and as tea. It is exceptionally well known all through South Asia; usually arranged with potatoes and presented with yogurt as an afterthought to counterbalance the severity (Krawinkel and Keding 2006, Rahmatullah, Jahan et al. 2010). In Pakistan, the severe gourd is by and large cooked with onions, red bean stew powder, turmeric powder, salt, coriander powder, and a spot of cumin seeds (Begum, Ahmed et al. 1997, Kenny, Smyth et al. 2013). Contingent upon the area, the intense gourd is otherwise called unpleasant melon, Karella or resin pear. Aside from the little natural products, or, in other words as 'Mithipagal' and it is developed in near parts of India including Tamil Nadu. It is a trailing climber yearly, which branches uninhibitedly, and semi-

calculated monoecious harvest term of 100-120 days. The significance of unpleasant gourd has been for some time perceived because of its high nutritive esteem furthermore, therapeutic properties. They are fantastic wellsprings of proteins, vitamins, sugars and minerals like calcium and iron. Likewise, they have vital restorative values which are utilized in some customary drugs. The leaf concentrate of the severe gourd is additionally having a decent Mosquitocidal impact (Yadav, Chaudhary et al. 2008, RANI 2014, MUTHAIAH 2015;Hassan et al. 2018). According to the dieticians, an individual ought to expend around 215 grams every one of verdant and different vegetables and 70 grams of root vegetables for our fair eating regimen of a standard day. In any case, it is too underneath (140 g day-1) against to this per capita proposal of the vegetables (Chikitsa and Sansthan 2014). Severe gourd is additionally generally developed in Tamil Nadu with a zone of more than 1,074 hectares with a yearly creation of 12.8 thousand tonnes. The normal creation is 10-15 tons for every hectare under typical administration rehearses (Chikitsa and Sansthan 2014).

It shows distinctive limitations in expanding the creation, out of this sex articulation is additionally a standout amongst the most essential one (Karuppaiah and Kathiravan 2006). The family is portrayed by different types of sex articulation fluctuating from strict gynoecious to bisexual and in addition monoecious is the most widely recognized one. Prior various endeavors have been rolled out to achieve improvement in sex articulation through hereditarily, natural and healthful control. Anyway, the utilization of various inorganic composts at prescribed dosages moves toward becoming vital devices in the specific regard. The privilege mix of inorganic composts at the prescribed dosages modifies the sex proportion in cucurbits as well as expands the respect a huge level (Karuppaiah and Kathiravan 2006, Bindiya 2011). Of all the above components, supplement administration frames the basic prerequisite for the foundation of any harvest (Bhatt and Khera 2006).

The current paper aims to carried out the effect of an inorganic nutrient on growth and yield characters of bitter gourd, and investigate the response of bitter gourd to different nitrogen levels, suitable time of sowing. Also find the effect of Phosphorus on roots, leaves, flowers, and fruits of bitter gourd.

MATERIALS AND METHODS

An experiment is conducted on bitter gourd entitled “Response of *Momordica charantia* L bitter gourd to different phosphorus doses and sowing dates”. The experiments were laid out in a randomized block design (RCB) with split plot arrangement. There were two factors considered i.e. Phosphorus level and sowing dates. Phosphorus levels kept in the main plot while sowing dates were kept in subplots. A total of 12 treatments were replicated. The field layout of twelve replicate was in (Table 1).

Analysis and Soil preparation

The soil was ploughed up thoroughly and they was level through the cutter, well, rotten farmyard manure was mixed with the soil. The recommended doses of available inorganic nutrient Di-ammonium Phosphate (DAP) were incorporated into the soil before the transplantation of seedling. Ridges made manually at the proper height. A space of 60 cm was kept between ridges while plant to plant space was kept 30 cm, a variety of bitter gourd were sown on ridges accordingly.

Nursery raising and Transplantation of seedlings

The preserved seeds of bitter gourd used in the experiment were taken from the market, which was sown in the designed plots 10th February, the second date of sowing 10th March, while the third sowing date is 30 March 2016. The seeds were watered after applied to soil to the requirements. The seedling of obviously equal height and vigor was transplanted on 05 April 2016. The seeding was immediately irrigated. Ridges were made manually at the proper height.

Plant height (cm)

Plant height data were recorded with help a measuring tape by measuring the height from the soil to the top of the main stem.

Numbers of branches per Plant^{-1}

The numbers of branches per plant data were collected by counting the total number of branches in selected plant originating from the main stem and their average was taken from each plant.

Days of flowering

The data for the days to flowering were taken by counting the days from the date of transplanting to first flowering initiations

Days of fruiting

Data from days of flowering taken by counting the days from the date of first flower initiations

Number of Fruits per Plant

From the days of Sowing to sitting of fruits were recorded, days before fruiting initiations

Yield per Plot

Yield per plot was calculated using the following formula

Yield/Plot= yield/plot= $\frac{yield\ plot-1\ (kg)\times 1000m2}{Plot\ area\ (m2)}$

Statistical analysis

The Experiment design through one way ANOVA, the data analyzed through SPSS and Excel.

Table 1 :Field layout was as below

Replication I			
P0	D1	D2	D3
P1	D3	D1	D2
P2	D2	D3	D1
P3	D1	D2	D3

Replication II.

P1	D3	D2	D1
P3	D1	D3	D2
P2	D2	D1	D3
P0	D3	D2	D1

Replication III

P3	D2	D1	D3
P2	D3	D2	D1
P0	D1	D3	D2
P1	D2	D1	D3

RESULTS

Following are the results obtained through the designed experiment

Effect of different levels on growth parameters

Plant growth characters are the important parameters reflecting the growth, vigor, stand of the crop ultimately decides the yields. The growth parameters were observed at 0, 40, 70 and 100 DAS of bitter gourd to study the effect of the treatments on growth.

Plant height

Under the influenced of different nitrogen levels on the plant height of bitter gourd at 0, 40, 70, and 100 DAS. Analysis of several of the data showed that plant height affected by various factors in Table 2. The Phosphorus and sowing dates and its interaction have considerable influence on plant height and revealed by the analysis of the data. The mean value level of phosphorus proved maximum plant height (108.45cm) was calculated for plant treated with 0kg ha^{-1}, followed by 101.23 cm receiving 40 kg ha^{-1} phosphorus whereas least plant height is 90.32 cm and recorded the treatment 100kg ha^{-1}, and found interaction effect significant. Most noteworthy plant stature was recorded for sowing date (108.45 cm) treated with 0 kg ha−1 phosphorus, where the most reduced plant tallness (90.32) was computed for sowing date in the control treatment. Plant stature is a job of the basic impact of natural connections; hereditary qualities develop furthermore, the healthful substance of the dirt. Data concerning plant height was recognizably influenced by cultivars and zinc dosages. Plant height at highest was watched for sowing date. These adjustments in stature of plants of various sowing dates can be a direct result of biological impacts or on the other hand, hereditary develops.

Moreover, the tallest plant was the one that was treated with 70 kg ha−1 phosphorus while least plant tallness was watched from phosphorus level 100 kg ha−1 the conceivable reason might be that zinc participates in chlorophyll arrangement which may have favored cell divisions, meristematic development in apical tissues, and augmentation of cell, what's more, combination of new cell divider. These results are in accordance with the disclosures; with expanding phosphorus portion the stature of the plant was additionally expanded.

Table 2: Effect of nitrogen level on bitter gourd vine length (cm), Fruit length (cm), Average fruit weight (g), Number of fruits per vine, Fruit yields plot $^{-1}$ (kg), Fruit yield plot ha^{-1} (kg).

Treatment of P	Sowing dates			Mean
	February 10	March 10	March 30	
0 kg ha-1(1)	128.97	98.29	98.79	108.68
40 kg ha-1 (2)	122.31	96.30	92.45	103.69
70 kg ha -1 (3)	112.34	92.65	89.67	98.22
100 kg ha-1 (4)	108.06 A	94.34A	106.23A	
Mean	117.92	95.40	96.80	

LSD for sowing dates: 2.667

LSD for Phosphorus level: 2.2301

Days of flowering

In table 3 Shows the statistical analysis

showed that sowing dates and phosphorus level and the interaction were significantly affected days to flowering. Anyway it is obvious from the normal estimation of different level of phosphorus that the plants that were connected with control treatment took more (number of days) days to bloom pursued by (number of days) getting 40 kg ha−1 phosphorus, while the plants provided with 70 kg ha−1 phosphorus took minimal number of days to bloom. Association impacts were discovered critical, be that as it may, utilization of 40 kg ha−1 phosphorus to sowing date took the most elevated number of days to blossom (number of days) and furthermore to sowing date at control treatment.

In the meantime, the base days to blooming (number of days) was noted for sowing date at 100 kg ha−1 phosphorus level. Information with respect to days to blooming was discovered noteworthy for phosphorus levels and sowing dates, yet blossoms show up on the plant in more days what's more, least days were recorded for the plant which might be credited to the varietal qualities of this sowing date.The highest number of days to flowering were ascertained with control treatment while minimum with 70 kg ha−1 phosphorus level.

Table 3: Effect of phosphorus and sowing dates on days of flowering in bitter gourd

Treatment of Phosphorus	Sowing dates			Mean
	February 10	March 10	March 30	
0 kg ha^{-1} (1)	52.123	54.234	48.000	C
40 kg ha^{-1} (2)	51.000	48.974	45.677	BC
70 kg ha^{-1} (3)	58.768	65.987	62.367	B
100 kg ha^{-1} (4)	56.240	42.876	70.654	A
Mean	54.5A	53.01A	56.67B	

Days of Fruiting

In table 4 the statistical analysis of the data showed that swooning dates, phosphorus, and their interaction were significantly affected days to fruiting.

In spite of the fact that it is obvious from the mean estimations of not at all like dosages of phosphorus that most astounding number of days to fruiting (5.2906) was computed for plants provided with 100 kg ha−1 phosphorus, trailed by (5.0000) getting control treatment, while minimum number of days to fruiting (8.0000) was noted for plants provided with 70 kg ha−1 phosphorus. The connection impact was discovered huge; anyway use of 100 kg ha−1 phosphorus to sowing date, took a greatest number of days to fruiting 5.000.

Additionally, the base measure of days to fruiting (10.333) was recorded for sowing date at 40 kg ha−1 phosphorus. Information with respect to days to fruiting was discovered unimportant for phosphorus levels and cultivars. Be that as it may, sowing date more days to fruiting, pursued by demonstrating date while leas days were noted for phosphorus the distinction noted might be days to fruiting were seen with 100 kg ha−1 phosphorus while least with 70 kg ha−1 phosphorus.

Table 4: Effect of sowing dates and phosphorus level in days of fruiting

Treatment of P	Sowing			Mean
	February 10	March 10	March 30	
0 kg ha-1 (1)	56.87 d	58. 22 d	65.68cd	60.25
40 kg ha -1(2)	62.86 cd	62.45 cd	56.44d	60.58
70 kg ha-1 (3)	64.98 bc	72.76 a	70.90 ab	69.54
100 kg ha-1 (4)	66.48 ab	76.62 cd	63.80 cd	68.96
Mean	62.80A	67.51Ab	64.20B	

Number of fruits per Plant

In table 5: Distinctive phosphorus portions, sowing dates, and their association came about in the significant impact on various natural products per plant. Looking at the normal principles for different levels of phosphorus uncovered that a most extreme number of natural products per plant 8.000 was noted for 70 kg ha−1 phosphorus while the slightest number of natural products per plant 5.000 was found in charge treatment. The most elevated quantities of natural products per plant 9.00 were noted for sowing date pursued by (5.6667) for March fourth and 5.46 were watched for sowing date. The association brought about a critical impact. The sowing date 25th February delivered the highest number of organic products per plant 10.333 were noted for 70 kg ha−1 phosphorus while a minimum number of organic products per plant (5.000)were found in charge treatment. Information in regards to organic products per plant was fundamentally impacted by phosphorus levels and sowing date. February 25th brought about a most extreme number of natural products per plant, while 4 and twelfth of March delivered least, which might be expected to the hereditary cosmetics of these sowing dates. Phosphorus at 40 kg ha^{-1}.

Table 5: A number of fruit per plant in a bitter gourd to different phosphorus level and sowing dates.

Treatment of P	Sowing			Mean
	February 10	March 10	March 30	
0 kg ha-1 (1)	6.333	4.000	4.111	4.81
40 kg ha-1 (2)	8.559	7.888	5.888	7.44
70 kg ha-1 (3)	10.555	5.666	6.872	7.69
100 kg ha-1\ (4)	7.000	5.000	4.482	5.60
Mean	8.111	5.638	5.338	

Table 6: Effect of sowing dates and phosphorus level on Bitter gourd weight of fruit

Treatment of P	Sowing date			Mean
	February 10	March 10	March 30	
0 kg ha-1 (1)	59.80 d	58.54 d	62.50 cd	60.28
40 kg ha-1 (2)	62.66 cd	64.42 cd	54.65 d	60.57
70 kg ha-1 (3)	66.33 bc	74.00 a	70.84 ab	70.39
100 kg ha-1 (4)	72.08 ab	68.44 cd	58.30 b	66.27
Mean	65.21A	66.32Ab	61.57B	

Fruit weight (g)

In table 6, Investigation of the change of the information demonstrated that diverse sowing dates, phosphorus levels, and their communication delivered an extensive effect on the organic product weight (Table 6). The methods estimations of various levels of Phosphorus uncovered the most elevated organic product weight (11.508 g) was watched for 70 kg ha−1 and the least (5.109 g) was recorded in charge treatment i.e. 100 kg ha−1. The most extreme natural product weight (8.333 g) was watched for sowing date February, 25th pursued by 5.39 g for Walk fourth while least natural product weight 5.61 g was found for sowing date Walk twelfth. The communication was additionally discovered critical. The application of 40 kg ha−1 phosphorus level delivered the most astounding natural product Wight that is 11.508 g albeit littlest organic product weight is 3.554 g and 5.109 was meant sowing date February 25th and March 12 individually with control and 40 kg ha−1 phosphorus level. Records on organic product weight were extensively influenced by sowing dates and phosphorus levels. Greatest natural product weight was noted for sowing date February, 25th and while a minimum measure of natural product weight was discovered for March, 4th Maximum.

DISCUSSION

The current experiment work entitled is done in spring seasons. Using Randomized complete block design (RCBD) with two factors Sowing dates and Phosphorus levels. The main plot represents Phosphorus levels and subplots represent sowing dates and three times replicated 12 treatments. Examination of difference disclosed noteworthy variety among the cultivars for every one of the characteristics under perception. Variety for the phosphorous level was additionally noteworthy for all attributes. The communication between the sowing date and phosphorous levels was seen as non-noteworthy for all the parameters. Methods for plant tallness for sowing dates at phosphorous level shows in the results, the tallest (60.825 cm) plant were delivered by the first (early sowing dates) which was 10 March 2016. While the most limited plants (57.133 cm) were created by late sowing dates which were 20 March 2016.

Revealed altogether higher natural product weight of 239.7 g, a number of organic products 15.8 vine-1, the organic product yield of 3.79 kg plant-1 and natural product yield ha-1of 33.7 tons with the use of 80 kg nitrogen-1in unpleasant gourd (Mulani, Musmade et al. 2007, Thriveni, Mishra et al. 2015)**.** Reported natural product weight of 23.24 g, number of organic products 15.3, natural product yield plant-1 of 3.42 kg and ha-1 of 30.8 tons with the utilization of 30 kg phosphorus alongside 30 kg P and 30 kg K ha-1 (Tripathy, Maharana et al. 1993; Nida Jan et al., 2018).

Announced that the greatest number of organic products was acquired with mix utilization of nitrogen potassium at higher portions in an unpleasant gourd (El-Gengaihi, Karawya et al. 1996). Examined the impact of various N, P and K levels on the development and yield of intense gourd and the outcomes demonstrated that the number of branches, breadth of organic product, yield per vine and yield per hectare were most noteworthy when 250 kg N, 50kg P_2O^5 and 100kg K_2O per hectare was connected (Sanap, Warade et al. 2010;Begium et al. 2019)**.**

Likewise found the consequences of the comparative pattern as deduced in the present examination (Rajasree and Pillai 2012). In another

ongoing investigation (Rajasree and Pillai 2012; Malik et al. 2018) used nitrogen up to 300 kg ha-1, and more elevated amounts of N nourishment lessened the ascorbic corrosive substance in natural products. More successive split utilization of supplement N or more prominent extent of natural source upgraded the time span of usability of organic products (Chaturvedi 2012)**.** The near examination of the aftereffects of the present investigation with those of revealed from various parts of the world showed that higher rates of nitrogen have turned out to be fundamental for accomplishing wanted yield results in the severe gourd. Be that as it may, the variety in the harvest yields an application rate of nitrogen are related with the provincial and natural variety especially connected with the dirt richness status (Chaturvedi 2012).

CONCLUSION

The current results conclude that Phosphorus level 70 kg ha^{-1} shows significantly best results, followed by 100 kg ha-1 phosphorus treatment, while the rest levels showed moderate results. The sowing dates 10 march shows the best sowing dates for bitter gourd cultivation and the Phosphorus levels should be 70 kg ha-1 or between 70kg ha^{-1} and 100kg ha^{-1}, will be fallowed on the quality of the soil.

CONFLICT OF INTEREST

The authors declared that present study was performed in absence of any conflict of interest.

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AUTHOR CONTRIBUTIONS

AR, MS, designed and performleed the experiments and also wrote the manuscript. AZ, SA, MAK, MR, RP, IK, MA, NA, and SA performed experiments, data analysis, ANOVA and designed experiments and reviewed the manuscript. All authors read and approved the final version.

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