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THE RESPONSE OF *CAPSICUM ANNUUM* L. GROWTH TO DIFFERENT PHOSPHORUS LEVEL AND SOWING DATES

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Abstracts

A field research was conducted in the horticulture nursery the University of Agriculture Peshawar during the period 25 February to 14 April 2013 on the response of chilli (*Capsicum annuum*) growth to phosphorus level and sowing dates, to know the suitable time of sowing for

better production of chilli, and know the optimum level of phosphorus for better growth of chilli. Amid split plot arrangements, the design used for the experiment was a randomized complete block design. Two factors involved i.e. Phosphorus levels and date of Sowing. Main plot constitutes Phosphorus levels whereas sowing date was in sub plot. Three times total 12 treatments were replicated. During this research of chilli different growth level study under phosphorous from sowing to plants ripeness and fruits. With the increase in Phosphorous level all parameters via, the height of plant, twigs no. and fruit number/plant increased significantly. Height of plant and twigs number increased significantly at its 1st blossoming and yield with an increase in P levels up to the cure while at final yield all parameters greatly improved up to the P2 treatment. The greatest plant tallness at final yield was obtained from P2 greatest numbers of fruits were presents in final P3 phosphorus levels. Phosphorus level (70 Kg ha^{-1}) showed significantly best results followed by (100 kg ha^{-1}). The rest of the phosphorus level showed moderate results. Early sowing date (25th February) was the best sowing date for bringel cultivation as compare the rest of the sowing dates. Thus it is recommended that bringel cultivation should be done during the 3rd week of February and the phosphorus level should be between 70 and 100 kg ha-1 depending on the soil type

Keywords: Chilli (*Capsicum annuum*), Growth, Phosphorus level, sowing dates

Introduction

Capsicum annuum is a domesticated species of the plant genus *Capsicum* native to southern North America and northern South America (Pickersgill, 1971; Prasad *et al*., 2006). This species is the most common and extensively cultivated of the five domesticated capsicums (Pickersgill 1971). The species encompasses a wide variety of shapes and sizes of peppers, both mild and hot, ranging from bell peppers to chilli peppers (Olaniyi *et al*., 2010). In the past, some woody forms of this species have been called *C. frutescens*, but the features that were used to distinguish those forms appear in many populations of *C. annuum* and there is no consistently recognizable *C. frutescens* species. Although the plant is not an annual and in the absence of winter frosts can survive several seasons and grow into a large perennial shrub. The single flowers are an off-white (sometimes purplish) color while the stem is densely branched and up to 60 centimeters (24 in) tall. The fruit is a berry and may be green, yellow or red when ripe. While the species can tolerate most climates, *C. annuum* is especially productive in warm and dry climates (Aminifard, *et al*., 2012).

Chilli peppers originated in the Americas. After the Columbian Exchange, many cultivars of chilli pepper spread across the world, used in both food and medicine (Perry *et al*., 2007). India is the world's largest producer, consumer, and exporter of chilli peppers (Perry *et al*., 2007; Subbiah and Ar, 2009). Among which the city of Guntur in Andhra Pradesh produces 30% of all the chilies produced in India, and the state of Andhra Pradesh contributes to 75% of all the chilli exports from India. Chilli peppers have been a part of the human diet in the Americas since at least 7500 BC (Subbiah and Ar, 2009). There is archaeological evidence at sites located in southwestern Ecuador that chilli peppers were domesticated more than 6000 years ago, and were one of the first self-pollinating crops cultivated in Central and South America (McLeod *et al*., 1983, Basu *et al*., 2003). Chili peppers have been a part of the human diet in the Americas since at least 7500 BC (McLeod *et al*., 1983). There is archaeological evidence at sites located in southwestern Ecuador that chili peppers were domesticated more than 6000 years ago, and were one of the first self-pollinating crops cultivated in Central and South America (Basu *et al*., 2003). Upon its introduction into Europe, chilis were grown as botanical curiosities in the gardens of Spanish and Portuguese monasteries. But the monks experimented with the chili culinary

potential and discovered that their pungency offered a substitute for black peppercorns, which at the time were so costly that they were used as legal currency in some countries (Eshbaugh 1975). The main objectives of the current work to know the suitable time of sowing for better production of chilli, and to know the optimum level of phosphorus for better growth of chilli

Materials and Methods

An experiment was conducted at Ornamental nursery, Department of Horticulture, The University of Agriculture Peshawar in February 2013. The design used in the experiment was a randomized complete block with split plot arrangement. There were two factors i.e. Phosphorus levels and date of sowing. Phosphorus levels were kept in the main plot while sowing date was in subplot. A total of twelve treatments were replicated thrice.

Soil Preparation and Analysis

Soil was ploughed up thoroughly and then was leveled through the cutter. Well, rotten farm yard manure was mixed with the soil. Recommended dose of Di-ammonium Phosphate (DAP) was incorporated into the soil before transplantation of seedling. Ridges will be made manually at the proper height. A space of 60 cm will be kept between ridges and 30cm, between plants. One variety of chilli (long green) and different doses of DAP will be applied to plots in accordance with the field layout.

Nursery Raising and Transplantation of seedlings

The seeds of chilli used in the experiment were taken from the market. Which were sown in pots on 25th February. The 2nd date of sowing was 4th March 2013 while the 3rd date of sowing in pots was 14th March 2013. The seed was watered after sowing. After that, the water was applied according to the requirements. The seedling of obviously equal height and vigor was transplanted on April, 12th 2013. The seedling was immediately irrigated. Ridges were made manually at the proper height. A space of 60cm was kept between ridges and 30 cm between plants Tab. 1.

Factor A (Phosphorus levels, kg ha^{-1})		**Factor B (Sowing dates)**	
P0:	Control	D1:	February 25th
P1:	60	D2:	4th March
P2:	80	D3:	April 14
P3:	100		

Parameters to be measured:-

Plant height (cm)

The data on plant height will be recorded with the help of a measuring tape by measuring the height from the soil to the top of the main stem.

Number of branches plant^{-1}

Data will be collected by counting a total number of branches in selected plants originating from the main stem and their average was taken.

Days to flowering

Data for days to flowering will be taken by counting the days from the date of transplanting to first flowering initiation.

Number of Seed per Fruit

Five plants will be selected randomly in each plot of each replication for number of fruits and their average will be calculated.

Number of fruits per plant

Five plants will be selected randomly in each plot of each replication for a number of fruits and their average will be calculated.

Yield/ Plot

Yield/ Plot was calculated using the following formulae:

$$yield/Plot = \frac{yield\ \ plot^{-1}\left(kg\right)\times 10000\ m^2}{plot\ \ area\ \left(m^2\right)}$$

Results and Discussion

Plant Height (cm):

Table 2 is showing the result relates to plant height (cm) of Capsicum Annuum sowing date and the ANOVA in Tab. 2. The sowing date & phosphorus level and interaction had considerable influence on plant height as revealed by the analysis of the data.

The mean values of various levels of phosphorus proved that uppermost plant height (63.778cm) was tabulated for plants treated with 0 kg ha^{-1} phosphorus, followed by (65.889cm) receiving 60 kg ha^{-1} phosphorus whereas least plant height (61.704cm) was recorded in treatment having 100 kg ha^{-1} phosphorus. The interaction effects were also found significant. Highest plant height was recorded for sowing date (57.667 cm) treated with 0 kg ha^{-1} phosphorus, where lowest plant height (55.667) was calculated for sowing date in control treatment. Plant tallness is a role of the

common influence of environmental interactions, genetics build up and nutritional contents of the soil. Information concerning plant tallness was noticeably effected by cultivars and zinc doses. Plant tallness at uppermost was observed for sowing date. These changes in height of plants of different sowing dates can be because of ecological effects or genetic build up. Furthermore, the tallest plant was the one that was treated with 80 kg ha^{-1} phosphorus while minimum plant height was observed from the phosphorus level 100 kg ha^{-1} the possible reason may be that phosphorus takes part in chlorophyll formation which may have favored cell divisions, meristematic growth in apical tissues, enlargement of cell and synthesis of new cell wall. These consequences are in line with the discoveries of Lahbib *et al.,* (2012). Who observed that with increasing phosphorus dose the height of plant was also increased.

Days to flowering:

The statistical analysis showed that sowing dates, phosphorus level and the interaction was significant as publicized in Table 3.However it is clear from the average value of various level of phosphorus that the plants that were applied with control treatment took more (number of days) days to flower followed by (number of days) receiving 40 kg ha^{-1}phosphorus, while the plants supplied with 70 kg ha^{-1}phosphorus took the least number of days to flower. Interaction effects were found significant, however, application of 60 kg ha^{-1}phosphorus to sowing date took the highest number of days to flower (number of days) and also for sowing date at control treatment. At the same time, the minimum days to flowering (number of days) was noted for sowing date at 100 kg ha^{-1}phosphorus level. Data regarding days to flowering was found significant for phosphorus levels and sowing date, yet flowers appear on the plant in more days and minimum.

Table 1. Field lay out will be as follow

Replication I

Po	D1	D2	D3
P1	D2	D3	D1
P2	D3	D1	D2
P3	D1	D2	D3

Replication II

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

Replication III

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

Table 2. Effect of sowing dates and different phosphorus levels effect plant height in bringel.

Treatment	Sowing dates			Mean
	1st	2nd	3rd	
0	57.667 BC	67.333 ABC	66.333 ABC	63.778 B
60	64.667 ABC	71.667 A	61.333 ABC	65.889 B
80	74.333 A	73.333 A	71.000 AB	72.889 A
100	55.667 C	64.667 ABC	64.778 ABC	61.704 B
Mean	63.083 A	69.250 A	65.861 A	

LSD for sowing dates: 2.776
LSD for phosphorus level: 2.093

Table 3. Effect of sowing dates and different phosphorus levels effect days to flowering in Chilli.

Treatment	**Sowing dates**			**Mean**
	1st	**2nd**	**3rd**	
0	49.667	50.000	48.667	49.444 B
60	52.333	55.000	47.333	51.556 B
80	59.000	56.667	58.667	58.111 A
100	48.333	53.333	48.222	49.963 B

Mean	52.333 A	53.750 A	50.722 AS	

LSD for sowing dates: 2.776
LSD for phosphorus level: 2.093

Table 4.Effect of sowing dates and different phosphorus levels effect days to fruiting in Chilli.

Treatment	**Sowing dates1st**				**Mean**
	1st	**2nd**	**3rd**		
0	42.667 CD	45.333 BCD	37.000 D		41.667 C
60	50.667 ABCD	45.000 BCD	41.333 D		45.667 BC
80	59.000 AB	67.000 A	63.667 A		63.222 A
100	46.333 BCD	47.000 BCD	57.444 ABC		50.259 B
Mean	49.667 A	51.083 A	49.861 A		

LSD for sowing dates: 2.776
LSD for phosphorus level: 2.093

Table 5. Effect of sowing dates and different phosphorus levels effect no of fruit in Chilli.

Treatment	Sowing dates				Mean
	1st	2nd	3rd		
0	43.333 A	47.333 A	41.667 A		44.111 A
60	41.333 A	44.333 A	50.000 A		45.222 A
80	53.000 A	52.333 A	51.667 A		52.333 A
100	48.333 A	45.667 A	48.556 A		47.519 A
Mean	46.500 A	47.417 A	47.972 A		

LSD for sowing dates: 2.776
LSD for phosphorus level: 2.093

Table 6. Effect of sowing dates and different phosphorus levels effect of fruit weight in Chilli

Treatment	Sowing dates			Mean
	1st	2nd	3rd	
0	5.0000	5.3333	5.6667	5.3333 B
60	6.3333	5.3333	5.3333	5.6667 B
80	7.3333	6.0000	7.0000	6.7778 A
100	5.6667	5.0000	5.0000	5.2222 B
Mean	6.0833 A	5.4167 A	5.7500 A	

LSD for sowing dates: 2.776
LSD for phosphorus level: 2.093

Figure 1. Represent the fruits of Chili plant with the addition of different phosphorous

days were recorded for the plant which may be credited to the varietal characteristic of this sowing date. Uppermost numbers of days to flowering were calculated with control treatment while minimum with 0 kg ha^{-1}phosphorus level. The current results is similar to the results of Jabeen and Mirza (2004) who reported a significant effect of phosphorus on days to flowering.

Days to fruiting:

The statistical analysis showed that sowing date, phosphorus doses and the interaction was significant as shown in Table 4. Though it is clear from the mean values of unlike doses of phosphorus that highest number of days to fruiting (50.259) was calculated for plants supplied with 100 kg ha^{-1}phosphorus, followed by (41.667) receiving control treatment, while least number of days to fruiting was noted for plants supplied with 0kg ha^{-1}phosphorus. The interaction effect was found significant; however, application of 100 kg ha^{-1} phosphorus to sowing date, took a maximum number of days to fruiting 50.259. Also, the minimum amount of days to fruiting (37.000) was recorded for sowing date at 0 kg ha^{-1} phosphorus. Data regarding days to fruiting was found significant for phosphorus levels and cultivars. However, sowing date more days to fruiting, followed by showing date while leas days were noted for phosphorus the difference noted may be days to fruiting were observed with100 kg ha^{-1} phosphorus while minimum with 60 kg ha^{-1}phosphorus. The following results are not in resemblance with the conclusion of Shamima and Islam (1989) which might be because of the difference in experimental methods and environmental condition.

A number of fruits per plant:

Tab. 5 showed the data recorded on number of fruits per plan and its analysis of variance I sequence. The different phosphorus doses, sowing dates, and interaction resulted in considerable effect on a number of fruits per plant as shown by both tables. Comparing the average standards for various levels of phosphorus exposed that a maximum number of fruits per plant 41.33 was noted for 60 kg ha^{-1}phosphorus while least number of fruits per plant 41.667 were found in control treatment. Highest numbers of fruits per plant 53.00 were noted for sowing date followed by (52.33) for March 2nd, and 47.417 were observed for sowing date. The interaction resulted in a significant effect. The sowing date 14th March produced uppermost numbers of fruits per plant 52.33 were noted for 80 kg ha^{-1}phosphorus while least number of fruits per plant (44.11) was found in control treatment. Data regarding fruits per plant was significantly influenced by phosphorus levels and sowing date. February 25th resulted in a maximum number of fruits per plant, while 4 &14th of March produced minimum, which may be due to the genetic makeup of

these sowing dates. Phosphorus at 80 kg ha^{-1}recorded maximum fruits per plant, also minimum amounts of fruits per plant were observed in control plots.

Fruit weight (g):

The data on the fruit weight of eggplant cultivars s give in table 6. The statistical analysis of the data showed that dissimilar sowing dates, phosphorus levels, and their interaction produced a considerable influence on the fruit weight. The means values of different levels of Phosphorus revealed the highest fruit weight (6.778g) was observed for 80 kg $ha^{-1}$and the lowest (5.667g) was recorded in control treatment i.e. 60 kg ha^{-1}. The maximum fruit weight (7.333g) was observed for sowing date February, 25th followed by 6.00g for March 4th while lowest fruit weight 5.00g was found for sowing date March 14th. The interaction was also found significant. The application of 80 kg ha^{-1} phosphorus level produced the highest fruit Wight that is 7.33g although smallest fruit weight is 5.00g and 6.00 was counted for sowing date February 25th and March 4th respectively with control and 60 kg ha^{-1} phosphorus level.

Records on fruit weight were considerably affected by sowing dates and phosphorus levels. Maximum fruit weight was noted for sowing date February, 25th and while least amount of fruit weight was found for March, 4^{th,} and 14th of March Maximum fruit weight was observed with the use of 80 kg ha^{-1}phosphorus, yet as minimum fruit weight from control treatments.

Summary

A trial entitled “Response of chilli to Phosphorus levels and dates of sowing” was conducted at Ornamental Nursery, Department of Horticulture, The University of Agriculture Peshawar in February 2013. The experiment was laid out in randomized complete block (RCB) design with split plot arrangements. There were two factors i.e. Phosphorus levels and dates of Sowing. Phosphorus levels were assigned to the main plot while sowing dates were kept in the subplot. The data on Number of branches $plant^{-1}$, Days to flowering, Days to fruiting, Number of fruits $plant^{-1}$ and Yield $Plot^{-1}$were significantly affected by phosphorus level and date of sowing. While the data on plant height was no significant. Overall results showed that early sowing date (February 25) produced significantly good results as compared to the rest of the sowing dates. Moreover, phosphorus level was also significantly affected the experimental parameters. Phosphorus level (70 kg ha^{-1}) produced significantly best results in all the parameters followed by Phosphorus level (100 $kgha^{-1}$) in almost all the parameters. The soil was thoroughly ploughed up and then was leveled through the cutter. Well, rotten farmyard manure was mixed with the

soil. The recommended dose of Di-ammonium Phosphate (DAP) was incorporated into the soil before the transplantation of seedling. Ridges were made manually at the proper height. A space of 60 cm was kept between ridges while plant to plant space was kept 30cm. A variety of chilli was sown on ridges accordingly.

The seeds of Chilli cultivars used in the experiment were taken from the market, which was sown in pots on 25th February. The 2nd date of sowing was 4th March 2013 while the 3rd date of sowing in pots was 14th March 2013. The seed was watered after sowing. After that, the water was applied according to the requirements. The seedling of obviously equal height and vigor was transplanted on April, 12th 2013. The seedling was immediately irrigated. Ridges were made manually at the proper height. Results of almost all the parameters showed that early sowing of Chilli is recommended with phosphorus level (70 & 100 kg ha^{-1}).

Conclusions

Phosphorus level (70 Kg ha^{-1}) showed significantly best results followed by (100 kg ha^{-1}). The rest of the phosphorus level showed moderate results. Early sowing date (25th February) was the best sowing date for bringel cultivation as compare the rest of the sowing dates. Thus it is recommended that bringel cultivation should be done during the 3rd week of February and the phosphorus level should be between 70 and 100 kg ha-1 depending on the soil type.

References

Ashok, P.K. and K. Upadhyaya, 2012. Tannins are astringent. J. Pharmacogn. Phytochem., 1: 45-50.

Ashrafuzzaman, M., Hossain, M.M., Ismail, M.R., Haque, M.S., Shahidullah, S.M., Zaman, S.U, 2009. Regeneration potential of seedling explants of chilli *Capsicum annuum*. J. Agri. Biol., 6: 2.

Basu, S. K., et al. (2003). "Capsicum: historical and botanical perspectives." Capsicum: the genus Capsicum 33: 1-15.

Eshbaugh, W. H. (1975). Genetic and Biochemical Systematic Studies of Chili Peppers (Capsicum- Solanaceae). *Bulletin of the Torrey Botanical Club*, *102*(6), 396. doi:10.2307/2484766

Fudholi, A., Othman, M. Y., Ruslan, M. H., & Sopian, K. (2013). Drying of MalaysianCapsicum annuumL. (Red Chili) Dried by Open and Solar Drying. *International Journal of Photoenergy*, *2013*, 1-9. doi:10.1155/2013/167895

Karima Lahbib,. (2012). Genetic diversity evaluation of pepper (Capsicum annuum L.) in Tunisia based on morphologic characters. *AFRICAN JOURNAL OF AGRICULTURAL RESEEARCH*, *7*(23). doi:10.5897/ajar11.2171

Khan, M.S.I., Roy, S.S., Pall, K.K, 2010. Nitrogen and Phosphorus Efficiency on the Growth and Yield Attributes of Capsicum. Acad. J. Pl. Sci. 3 (2): 71-78.

Ludilov, V.A., Ludilova, M.I, 1977,1975. Application of high rate of mineral fertilizers in capsicums and eggplant. Nauchnye Trudy NII Ovoshch. Khva. 3:58-63. (Hort. Abst.1977,47 (1): (1975) 524).

Maheshwari. (2011). Assessment of genetic diversity among Capsicum annuum L. genotypes using RAPD markers. *AFRICAN JOURNAL OF BIOTECHNOLOGY*, *10*(76). doi:10.5897/ajb11.497

McLeod, M. J., Guttman, S. I., Eshbaugh, W. H., & Rayle, R. E. (1983). An Electrophoretic Study of Evolution in Capsicum (Solanaceae). *Evolution*, *37*(3), 562. doi:10.2307/2408269

Misra, S., Lal, R. K., Darokar, M. P., & Khanuja, S. P. (2011). Genetic Variability in Germplasm Accessions of Capsicum annuum L. *American Journal of Plant Sciences*, *02*(05), 629-635. doi:10.4236/ajps.2011.25074

Mohammad Hossein Aminifard. (2012). Effect of plant density and nitrogen fertilizer on growth, yield and fruit quality of sweet pepper (Capsicum annum L.). *AFRICAN JOURNAL OF AGRICULTURAL RESEEARCH*, *7*(6). doi:10.5897/ajar10.505

Narmin, Y.S., Jamei, R., Heidari, R, 2012. Antioxidant activities of two sweet pepper *Capsicum annuum* L. varieties phenolic extracts and the effects of thermal treatment. Avicenna J. Phytomedicine. 3(1): 25-34.

Nyla, J. and Mirza, B, 2004. Ethyl Methane Sulfonate Induces Morphological Mutations in (*Capsicum annuum*). *Asian Journal of Plant Sciences*, *1*(4), 425-428. doi:10.3923/ajps.2002.425.428

Olaniyi, J., et al. (2010). "The effect of organo-mineral and inorganic fertilizers on the growth, fruit yield, quality and chemical compositions of okra." Journal of Animal & Plant Sciences **9**(1): 1135-1140.

Perry, L., Dickau, R., Zarrillo, S., Holst, I., Pearsall, D. M., Piperno, D. R., … Zeidler, J. A. (2007). Starch Fossils and the Domestication and Dispersal of Chili Peppers (Capsicum spp. L.) in the Americas. *Science*, *315*(5814), 986-988. doi:10.1126/science.1136914

Pickersgill, B. (1971). Relationships Between Weedy and Cultivated Forms in Some Species of Chili Peppers (Genus capsicum). *Evolution*, *25*(4), 683. doi:10.2307/2406949

Prasad, B. C., Kumar, V., Gururaj, H. B., Parimalan, R., Giridhar, P., & Ravishankar, G. A. (2006). Characterization of capsaicin synthase and identification of its gene (csy1) for pungency factor capsaicin in pepper (Capsicum sp.). *Proceedings of the National Academy of Sciences*, *103*(36), 13315-13320. doi:10.1073/pnas.0605805103

Shamima, N. and Islam, M.S, 1989. Response of chilli to NPK and S fertilization. Bangladesh Hort. 17(2): 5-9.

Sharfun, N., Mushtaq, M. and Pathan, I.H, 2004. Seed-borne mycoflora of *Capsicum annuum* imported from India. Pak. J. Bot. 36(1): 191-197.

Subbiah, A. and S. JeyAkumAr (2009). "Production and Marketing of chillies." Facts for You 29(6): 1-19.