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Research Article

Effect of Phosphorus Application on Performance of Cauliflower (*Brassica oleracea var. botrytis*) Varieties

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Abstract

Phosphorus (P) is an essential nutrient for the growth and production of cauliflower. Inadequate application of P in soil have led to severe P deficiency in our country. Low soil pH reduces the availability and uptake of P to plants. Increased soil application of P can be an effective way to increase the curd yield in cauliflower. A field experiment was undertaken at Sundarbazar municipality during September, 2017 to January, 2018 to evaluate the effect of four levels of soil application of P (0 kg ha^{-1}, 100 kg ha^{-1}, 120 kg ha^{-1} and 140 kg ha^{-1}) on four cauliflower varieties (Kathmandu Local, Jyapu Local, Snow Mystique and Snow Grace). The treatment combinations were repeated 3 times and were arranged in Random Complete Block design. The effects were observed over average number of leaves, days to curd initiation, curd weight, root length and yield. The findings of this study showed that the soil application of P showed significant effect on curd weight, root length and yield. At 140 kg ha^{-1}, Snow Grace expressed highest average curd weight (1.1060 kg $plant^{-1}$) and highest yield (22.1 t ha^{-1}) as compared to other levels of P.

Keywords: Curd Weight; Phosphorus; Root Length; Yield

Introduction

Phosphorus (P) is one of the most essential plant nutrients that influence the growth and productivity of cauliflower. In dry basis, it occurs in concentration of 0.1 - 0.5% lesser than N in Plants. Although, it is absorbed in small amounts by plants [1], it is a key element in many physiological [2] and biochemical process. Therefore, P management is crucial for production and productivity in cauliflower [3]. In world, more than half of the cropland is low in plant available P and poses severe threat especially in poor and remote communities. Usually P should be applied at high dose due to low efficiency of phosphate fertilization [4]. But, Nepalese farmer are unaware about the use of phosphate fertilizer which has resulted in less use of phosphate fertilizer imposing problems in crop production [5]. In cauliflower, P deficiency directly affects the inflorescence initiation, curd formation, curd size and root development. P deficiency is most common in both acidic [6] and alkaline soils [7]. And P is found to be naturally low in tropical soils.

Although, several researches have been carried out on P requirement of cauliflower but on this aspect, there is limited information under Nepalese soil condition. Moreover, there is no research being carried out in response of cauliflower varieties in different level of P. Therefore, the present research was conducted to determine the effect of different level of P in yield of cauliflower varieties. The present research also helps to contribute to site specific P management in soil in different cauliflower varieties. And it is hypothesized that addition of P in the soil would have significant effect in cauliflower varieties.

Materials and Methods

The experiment was carried out at Sundarbazar municipality of Lamjung districts. The soil of experimental field was analyzed for total nitrogen, available phosphorus, available potassium, organic matter and soil pH (Table 1). Composite soil sample from the field were collected following the random sampling method from 12 different points, a month before the land preparation using core

sampler. Then it was separated into four parts, keeping two diagonal parts and two parts eliminated, carried out until we reached the required amount of soil to be tested was sent to soil management directorate, lalitpur for analysis. Field experiment was conducted during September, 2017 to January, 2018 in randomized complete block design with double factors consisting of 16 treatment combinations with three replications. Macro nutrients were applied at the rate of 100:100 kg NK ha^{-1} and phosphorus according to the treatments. Half dose of Urea was applied as a basal dose and remaining half in two splits doses at 30 and 60 Days after transplanting (DAT). Micronutrients Boron (B) and Molybdenum (Mo) were applied at the rate of 2 kg ha^{-1} and 75 ppm and Mo was applied in three split dose 20, 40 and 60 DAT. P (Single Super Phosphate as a source) was applied at the levels of 0, 100, 120 and 140 kg ha^{-1}. The seeds of cauliflower varieties; Kathmandu Local, Jyapu Local, Snow mystique and Snow grace were obtained from local market of Sundarbazar municipality.

Soil available pH	4.8	Acidic
Soil available organic matter	2.62%	Medium
Soil available Nitrogen	0.13%	Medium
Soil available Phosphorus (kg ha^{-1})	13.05	Very Low
Soil available Potassium (kg ha^{-1})	82.3	Low
Soil available Boron (kg ha^{-1})	0.3	Low

Table 1: Chemical properties of sampled soil.

Seeds of all four cauliflower varieties were sown in separate plots in poly house on September, 2017. 30 days old seedlings were transplanted on October, 2017 in main field with crop geometry of 50 cm × 50 cm. Healthy and uniform sized seedlings were selected for transplanting. Dead seedling was replaced by healthy one within a week. Intercultural operations were carried out at the time of urea top dressing. Harvesting was done on January, 2018. The crops were regularly observed to note down the curd initiation in different varieties. Appearance of white head of cauliflower was noted and data was obtained by counting from the date of seed sowing to the appearance of curd and was presented in days. Root length of cauliflower varieties was recorded by measuring with scale of four randomly selected plant. The weight of curd was recorded by weighing curd of four randomly selected plants and curd weight $plant^{-1}$ and yield $hectare^{-1}$ were calculated.

The data recorded was statistically analyzed according to Random Complete Block Design with double factor using a statistical package GENSTATC 15th edition.

Result and Discussion

Root length

Cauliflower varieties and phosphorus levels are significantly different but interaction between them are non-significant (Table 2). Irrespective of varieties, Increased in P levels increases root length having maximum at 140 kg ha^{-1} (23.39 cm) and minimum at control treatment (2.58 cm). In terms of variety, Jyapu Local had maximum root length (23.39 cm) and Snow Grace had minimum root length (18.74 cm). All the varieties showed increased root length with increase in P level. This might be due to the fact that P increases physiological processes in the plant system which leads to increase the growth rate, which ultimately helps in stimulation of root length in plants. Kumar., *et al.* [8] and Uddain [9] found the same trend of results.

Curd weight

Cauliflower varieties shows highly significant difference in different level of Phosphorus (Table 2). Irrespective of varieties, curd weight $plant^{-1}$ increased with increased P level with maximum curd weight $plant^{-1}$ in 140 kg P ha^{-1} (0.9146 kg $plant^{-1}$) and minimum curd wt $plant^{-1}$ was in 0 kg ha^{-1} (0 $plant^{-1}$). In terms of varieties, Snow Grace had higher curd wt. $plant^{-1}$ (0.6700 kg $plant^{-1}$) and Kathmandu Local had lower curd wt. $plant^{-1}$ (0.4547 kg $plant^{-1}$). All the varieties showed increased curd weight with increased P level. This may be due to P being structural part of Phospholipids, nucleic acid and co-enzyme (NADH and FADH) that helps in kreb's cycle and glycolysis in ATP formation, which improves the quality and quantity of curd [9]. Experimental field being low in P and having low P^{H}, P availability is low as well as there will be less uptake [6]. Therefore, plants of controlled treatment are adversely affected in early stage of plant development which results stunted, weak and retarded growth resulting no curd formation. Katiyar., *et al*. [10] also reported that higher P level (90 kg ha^{-1}) produce more weighed curd over lower levels of P which was in the line with finding of Elahi., *et al*. [11] and Islam., *et al* [12].

Yield

Cauliflower varieties showed significant difference at different level of phosphorus application (Table 2). Higher 140 kg P ha^{-1} application had maximum yield $hectare^{-1}$ in cauliflower varieties (18.29 t ha^{-1}) and minimum yield $hectare^{-1}$ was in without application of P (0 t ha^{-1}). Variety Snow grace had maximum yield hectare-1 (13.40 t ha^{-1}) and minimum yield $hectare^{-1}$ was in Kathmandu Local (9.09 t ha^{-1}). All the experimented varieties had increased yield $hectare^{-1}$ with increase in P level. The results of the study

clarified that increased P level increases the yield hectare^{-1} of cauliflower plants. McPharlin., *et al.* [13] found that P helps in increment of photosynthesis and proper curd formation. Sheppard and Bates [14] reported that yield and chemical composition are related with P level. Elahi., *et al.* [11] found that vigorous growth of the plant is correlated with proper nutrition. Sharma., *et al.* [15] and Reddy., *et al.* [16] in cauliflower have similar results to present finding.

Phosphorus	Root length (cm)	Curd weight (kg)	Yield (t ha^{-1})
0 kg ha^{-1}	2.58^{d}	0.00^{d}	0.00^{d}
100 kg ha^{-1}	24.21^{c}	0.54^{c}	10.86^{b}
120 kg ha^{-1}	28.03^{b}	0.73^{b}	14.68^{c}
140 kg ha^{-1}	30.27^{a}	0.94^{a}	18.29^{a}
F-test	**	**	**
Varieties			
Kathmandu Local	21.83^{a}	0.46^{c}	9.09^{c}
Jyapu Local	23.39^{a}	0.51^{bc}	10.24^{bc}
Snow mystique	21.11^{a}	0.55^{b}	11.10^{b}
Snow Grace	18.74^{b}	0.67^{a}	13.40^{a}
F-test	*	**	**
Phosphorus *Variety			
Grand mean	21.27	0.55	10.96
F-test	NS	**	**

Table 2: Effect of Phosphorus level on cauliflower varieties root length, curd weight and yield.

Similar letter in uppercase indicate non-significant (NS) at 1% (**) and 5% (*) level of significance.

Conclusion

Application of P in the soil increases curd weight and root length which finally increases the yield. However, varieties response to soil application of P also affect the yield. As curd yield is the most economically important parameters, Snow grace is found to be more P efficient having maximum yield at 140 kg P ha^{-1}. Furthermore, research is required to quantify these effects at different location of Lamjung district.

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Volume 2 Issue 9 September 2018