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Performance of Varieties of Cauliflower (*Brassica Oleracea Var. Botrytis*) Under Different Levels of Phosphorus Application in Pot Culture at Lamjung, Nepal

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ABSTRACT

Judicious P fertilizer management is one of the best strategies to increase its yield cauliflower yield in Nepal. A pot experiment was conducted at Lamjung Campus during October, 2018 to February, 2019 to investigate the effect of five levels of soil application of P (0 kg ha^{-1},100 kg ha^{-1}, 120 kg ha^{-1}, 140 kg ha^{-1} and 160 kg ha^{-1}) on growth and yield of two cauliflower varieties (Kathmandu Local and Snow Grace). Hence, the experimental design was two factorial Complete Randomized Designs (CRD) with four replications. The result revealed that the soil application of P showed significant effect on all growth and yield attributes of cauliflower cultivars. Values for plant height (28.18 cm), days to curd initiation (76.12 days), number of leaves (18.38), root length (28.76 cm), curd weight (0.750 kg plant^{-1}) and yield ha^{-1} (27.54 t ha^{-1}) were significantly higher at 160 Kg ha^{-1} P input and Snow Grace expressed higher curd weight (0.83kg^{-1} plant) and yield (31.07 t ha^{-1}) at P level of 160 kg ha^{-1} than other treatments. Varieties and P level interacted significantly for plant height, curd weight and curd yield. It was concluded that application of P (160 kg ha^{-1}) can increase the yield in cauliflower and Snow Grace perform better than Kathmandu Local.

Key words: *Cauliflower; Curd initiation; Curd yield; Phosphorus*

Introduction

In plants, Phosphorus (P) is one of the major nutrients and contains 1-5 g P kg^{-1} dry matter. Similarly, soil solid possess 0.02-5 g kg^{-1} P, the average being 0.5 g kg-1. Plants absorb P in the form of either H_2PO_4- or as HPO_{42}- depending on soil pH .The growth and development of cauliflower is directly influenced by the application of P as this element involved in many physiological and biochemical process although it is absorbed in small amounts by plants [1,2]. It is least mobile in the soils and hence is less available to plants in most soil conditions. Globally, P deficiency in the soil and plant is major abiotic stress as it affects crop productivity on 30-40% of the world's arable land Von Ueskull and Mutert [3,4]. P is deficient in about 42% of total cultivated land of Nepal (MOAD 2072) and is the principal yield limiting factor for cauliflower production. Most of the Nepalese farmers use the chemical fertilizers randomly without considering the soil P status, crops demand and its negative impact to the soil and ecology. For example, even the government recommendation (120 kg ha^{-1} when the plant available P in the soil is reported to be low) for the cauliflower ignores the varietal specific need. Further, there is limited number of studies regarding the yield response to the higher level of the soil P input which is one of the major challenges of commercialization production of cauliflower in Nepal. Judicious and balance use of P fertilizer as well as site specific P fertilizer management is one of the best alternative strategies to increase the production per unit limited area of production; and it is hypothesized that addition of P in the soil can significant contribute on cauliflower production. Since, soil and crop demand-based P application is lacking, we considered that the soil input of P changes the growth and yield of cauliflower and such response varied with the cauliflower varieties. The present study aims to contribute to optimize the P input via comparing the performance of the two cauliflower varieties.

Materials and Methods

This experiment was carried out at Sundar bazar municipality of Lamjung districts from October 2018 to February, 2019 to assess the effect of soil P input on yield and yield attributes in cauliflower varieties. Soil was collected from horticulture farm of IAAS, Lamjung Campus and was analyzed for total nitrogen, available potassium, organic matter and soil PH in Laboratory of Soil Management Directorate, Harihar Bhawan Lalitpur (Table1). Then, we under took two factorial experiments- levels of Pinputs and cauliflowers as factors. Two commonly grown varieties of cauliflower (Kathmandu Local and Snow Grace) were purchased from local market and seedling was raised for 29 days. We mixed the air-dried soils with air dried farm yard manure (0.5 kg cattle manure Kg-1 Soil) and filled in polypot (4 kg soil pot^{-1}).

In each pot, nitrogen (N), urea, potassium (K_2O), potassium chloride, Boron (B), sodium borate and Molybdenum (Mo), Sodium molybdate were applied at the rate 11.73 g, 3.6 g, 0.49 g and 5.12 mg respectively. After applying five levels of the P (0 $kgha^{-1}$, 100 $kgha^{-1}$, 120 kgha-1, 140 $kgha^{-1}$, and 160 kg ha^{-1}) using single super phosphate, we transplanted seedling of cauliflower in the pot and arranged the pots incompletely randomized designed with four repetitions. The combination of treatments shown in Table 2. Nitrogen was top dressed at the rate of 2.93 g in 30 days and 60 days after transplanting. Soil was kept at 50-65% field capacity during the entire growing period. Before harvesting the plants at physiological maturity, plant height, leaves numbers, days for days required for the curd initiation and physiological maturity were recorded was measured. After harvesting, root length and curd yield were measured. The mean separation was carried out with ANOVA using package SPSS software version 24 edition and graphs were developed using Origin Software. The data recorded was statistically analyzed according to Complete Block Design (CRD) and means were compared using Duncan's multiple Range test (Table 1).

Table 1: Chemical properties of soil used in the experiment.

Parameter	Value	*Ranking
Soil available pH	5.8	Acidic
Soil available organic matter (tha^{-1})	1.642	Low
Soil available Nitrogen	0.08%	Low
Soil available Phosphorus (kg ha^{-1})	7.75	Very low
Soil available Potassium (kg ha^{-1})	536.26	High
Soil available Boron (µg g^{-1})	1.8	Medium
Ranking of the soil properties according to Pradhan		

Results and Discussion

Plant height

Our experimental result reveals that both the main effect of P level and cauliflower varieties as well as their interaction effect onthe plants height were significant (P 0.01) (Table 2). Irrespective of the variety, plant at 160 kg ha-1 P (28 cm) was significantly taller than at lower P levels. P plays a vital role in root development and nutrient intake that increase plant growth and ultimately influence plant height. P also helps in the efficiency of nitrogen uptake, which enhanced vegetative growth of plants [5,6]. Also found the similar effect of P in their investigation. Irrespective of the P levels, Kathmandu Local was significantly taller than the Snow Grace. It indicates that effect of genetic makeup of the varieties on this trait.

Number of leaves

Input of increasing P levels significantly increased the number of leaves in cauliflower plants ($p<0.01$). The leaf numbers at plotthat received 160 kg P ha^{-1} (18.38) was about 18.4 which as more than doubled as compared to that of control of no P input and43% higher than that of the 120 kg P ha-1. Cauliflower varieties also differ in terms of producing the leaf numbers and these two factors did not significantly interact each other to produce the number of leaves. Compared to the Kathmandu Local, Snow Grace had more leaves per plant (15.35) which was significantly superior over Kathmandu Local variety (13.50). At each level of the P, Snow Grace exhibited significantly higher number of the leaves in each plant except at 160 kg P ha^{-1} in which the value was not significant with Kathmandu Local. The increased number of leaves per plant with increased level of P might be due to its vital role in photosynthesis, energy storage, cell division and cell enlargement that helps in enhancement of number of leaves. Randhawa and Bhail reported that higher dose of P gave positive response in increasing the numbers of leaves. Similarly, found significant influence of P input on number of leaves per plant of cauliflower [7]. The number of leaves perplant varied with varieties due to their own genetic makeup which is linked with inters nodal length.

Days to curd initiation

Levels of P addition to soil also significantly influenced the crop duratin (P 0.01) such that the increasing P levels decreased the days to initiate the curd in cauliflower. Hence, while the curd initiation was recorded at 93 days after sowing in plots that received no P input, the plots that received 160 Kg P ha^{-1} exposed curds almost 16 days earlier. Similarly, Snow Grace started to expose the curd at 81 days after sowing-that is 9 days earlier than the Kathmandu Local. At each P level, the days to curd initiation was less for the Snow Grace compared to the Kathmandu Local. Snow Grace exhibited the curd at 78 days when 160 Kg ha^{-1} P was applied and which-compared to the control of 0 Kg ha^{-1} P input is 19 days earlier than at for the same variety and 28 days earlier than Kathmandu Local. Hence, P might involve metabolic activities in cauliflower that are vital for enhancing the vegetative growth and the promotion of flower primordial formation earlier [8,9]. In their investigation found that P had significant effect on the days required to curd initiation and improved flower formation and curd initiation.

Root length

Soil application of different levels of P and cauliflower varieties significantly altered the root length and varietal responses differed (P 0.01). The cauliflower produced longer root with application of 160 kg P ha^{-1} (28.7 cm) relative to the root length at control plots of no P application (12.5 cm). At all levels of the P inputs, Kathmandu Local had significantly longer roots than Snow Grace. The application of P stimulates cell division in the meristematic region and lead to higher concentration of bioactive gibberellins (GA) that may promote the root growth. [10]. Stated that increasing P supply increased root growth [10].

Curd yield

The figure 1 depicts the curd weight per plant and curd yield (t ha^{-1}). Like yield traits, the cauliflower varieties showed higher curd yield with increasing levels of P input. Irrespective of the varieties, maximum mean curd weight (0.750 kg) was recorded with application of 160 kg P ha^{-1} 145, which was nearly 4.5 times higher than at control plotwith no P input. Snow Grace had higher mean curd weight (0.52 kg) than Kathmandu Local (0.406 kg). At 160 kg P ha-1 application, curd weight per plant was about 840 g for Snow Grace; and this was about 180 g more than that of Kathmandu Local found that P had significant influence on curd weight of cultivars and vigorous growths of the plant are correlated with proper nutrition [10]. P helps in 150 increment of photosynthesis and proper curd formation[11-13]. Singh also reported the higher curd weight in the plant at increase soil P application. Similarly, Sheppard and Bates reported that yield and chemical composition are related with P level [14]. The yield was influenced by the yield containing parameters of the cauliflower which is similar with result reported by Sharma [13]. Our results also concurred with the finding of many investigators like Reddy AR and Sharma SK finding [12,13]. Snow Grace had higher mean curd yield (19.5 t ha^{-1}) than Kathmandu Local (14.9 t ha^{-1}). The cultivars highly influenced the curdyield as curd yield is determined by environmental factors as well as genetic factors of the species. Despite Snow Grace expressed shorter root, curd yield was higher than Kathmandu Local, and this might be due to higher P uptakecapacity of the roots (Figure 1) (Table 2).

Table 2: Effect of different levels of phosphorus and varieties on yield parameters in two cauliflower varieties.

P level (Kg ha^{-1})	Variety	No. of leaves		Days to Curd Initiation	Days to harvest	Root length
0	Kathmandu	7.8g	13.2ef	98.3a	128.3a	15.2d
	Local	-	-	-	-	-
	Snow Grace	10.0f	12.1f	88.8c	116.3d	9.9e
100	Kathmandu	-	-	-	-	-
	Local	12.0e	19.5d	92.3b	123.5b	20.7c
	Snow Grace	13.8d	15.3e	84.0d	109.3f	16.3d
120	Kathmandu	-	-	-	-	-
	Local	14.8d	25.7b	90.5bc	119.5c	21.4c
	Snow Grace	16.5bc	19.3d	82.8de	106.0g	16.9d
140	Kathmandu	-	-	--	-	-
	Local	15.5cd	26.2b	89.5c	119.0c	25.8b
	Snow Grace	17.3b	18.9d	80.5e	105.5g	22.0c

160	Kathmandu	-	-	-	-	-
	Local	17.5ab	33.3a	82.3de	112.5e	30.4a
	Snow Grace	19.3a	23.0c	70.0f	102.0h	27.1b
Sig	-	***	***	***	***	***
SEm (±)	-	0.412	0.527	0.587	0.506	0.472
LSD	-	1.19	1.523	1.696	1.462	1.363
P level *	-	-	-	-	-	-
Variety	-	ns	**	ns	ns	ns

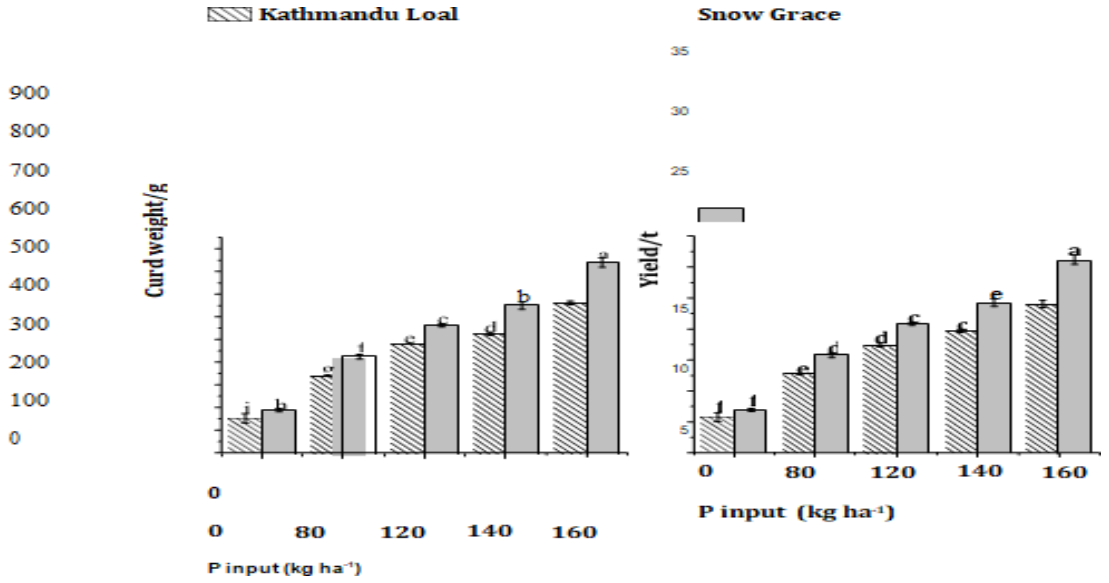

Figure 1: Curd yield of the two cauliflower varieties grown at five levels of P inputs in Sundar bazar Lamjung.

Conclusion

The finding of this study shows that increased level of P application can improve the growth and other yield parameters of cauliflower. P input in the soil enhances the root length, number of leaves; hasten reproductive stage and increases curd weight which finally increases the yield. However, varieties response to soil application of P varies. Snow Grace Variety appears to be more responsive to soil P input than Kathmandu Local. As peak level for all the traits was not met here in present study, further research is required with wider levels of P application for enhancing the cauliflower yield.

References

1. Balyan DS, Dhankar BS, Rahul DS, Singh KP. Growth and yield of cauliflower variety Snowball-16 as influenced by nitrogen, phosphorus and zinc. Haryana J Hort Sci. **1988**, 7:247-254.

2. Castoldi R, Charlo, Vargas, Pablo F, Braz T, et al. Crescimento, acúmulo de nutrientes e produtividade da cultura da couve-flor. *Hortic Bras*. **2009**, 27:438-446.

3. Elahi E, Wali A, Ayub G, Ahmed S, Huma Z, et al. Response of cauliflower (*Brassica oleracea* L. *botrytis*) cultivars to phosphorus levels. *Pure Appl Biol*. **2015**, 4:187-1947.

4. Von UHR, Mutert E. Global extent, development and economic impact of acid soils. *Plant Soil*. **1995,** 171: 1-15.

5. Hinsinger P. Bioavailability of soil inorganic P in the rhizosphere as affected by root induced chemical changes: A review. *Plant Soil.* **2001**, 237:173-195.

6. Islam MH, Shaheb MR, Rahman S, Ahmed B, Islam, et al. Curd yield and profitability of broccoli as affected by phosphorus and potassium. *Int J Sustain Crop Product*. **2010**, 5:1-7.

7. Dheerendra K, Tripathi SM, Dwivedi AK, Vivek, P. Effect of nitrogen and phosphorus on crop growth, head yield and quality of broccoli (*Brassica oleracea* L. *var. italica*). *HortFlora Res Spectr*. **2012**, 1:172-174.

8. KIM HJ, Lynch JP, Brown KM. Ethylene insensitivity impedes a subset of responses to phosphorus deficiency in tomato and petunia. *Plant Cell Environ*. **2008**, 31:1744-1755.

9. Kumar K, Goh KM. Crop residues and management practices: effects on soil quality, soil nitrogen dynamics, crop yield, and nitrogen recovery. *Adv Agron*. **1999**, 68:197-319.

10. Marković S, Čereković N, Todorović V, Kljajić N, Mihajlović D, et al. The content of NPK 220 nutrients in vegetative organs of cauliflower (*Brassica oleracea var. botrytis* L.) grown in soilless culture technique. *Agroznanje.* **2012**, 13:633-644.

11. McPharlin IR, Robertson WJ, Jeffery RC, Weissberg R. Response of cauliflower to phosphate fertilizer placement and soil test phosphorus calibration on Karrakatta sand. *Commun Soil Sci Plant Anal*. **1995**, 26: 607-620.

12. Reddy AR, Padmaja G. Effect of phosphorus and zinc on curd yield and quality of cauliflower. *J Res Angrau*. **2005**, 33:65-98.

13. Sharma SK, Sharma R, Korla BN, Sharma R. Effect of nitrogen and phosphorus on the growth and seed yield of sprouting broccoli cv. *Green Head Hort J*. **2002**, 15:87-90.

14. Sheppard SC, Bates TE. Yield and chemical composition of rape in response to nitrogen, phosphorus and potassium. *Canadian J Soil Sci*. **1980,** 60:153-162.