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Response of cauliflower (*Brassica oleraceae* var. *botrytis* L.) to N, Mo and Mg fertilization under poultry manure condition

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Abstract

An experiment was conducted to investigate the effect of foliar fertilization on growth and yield of cauliflower (*Brassica oleraceae* var. *botrytis* L.) under poultry manure condition at farmer's field Marghazar, Mansehra, during 2012-13. The experimental treatments were T_0 = Control (Urea) 123.5 kg ha^{-1}, T_1 = N + Mo + Mg foliar spray [4%N + (Mo) 50 mg L^{-1} + (B) 80 mg L^{-1}], T_2 = Urea + N foliar spray (123.5 kg ha^{-1} + 2% N), T_3 = foliar spray 4% N and T_4 = foliar spray 8% N. The results revealed that T_1 [4% N + (Mo) 50 mg L^{-1} + (B) 80 mg L^{-1}] significantly increased the root length, leaf length, plant fresh weight, curd weight, circumference of curd and curd yield. Foliar spray 8% N gave the maximum values for plant aerial part, plant height, root fresh weight and dry weight which may be due to the excess of nitrogen while minimum values for all the studied attributes were examined in Control (Urea) 123.5 kg ha^{-1}. From these results it could be suggested and recommended that nitrogen in combination with micronutrients (Mo and B) are the most essential plant mineral nutrients in foliar fertilization method for growth and curd yield of cauliflower under poultry/chicken manure condition.

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Introduction

Cauliflower (*Brassica oleraceae* var. *botrytis* L.) is a vegetable crop cultivated for its white curds. It represents the aristocrat of the family cruciferae for its delicate growing requires more devotion than broccoli, cabbage and its close cruciferous relative (Splittstoesser, 1990; Abdel-Razzak and El-Nasharty, 2008).

Since prehistoric time, for agricultural production the organic manure has been documented as efficient fertilizers. A tradition has been moved this century-long towards inorganically based fertilizers to produce maximum foods to feed the ever increasing population, truly for Asia. Due to the improvement of crop breeding, plant mineral nutrients in excess of soil reserves are crucial for maximizing the yield. Despite its retention uncertainty in soil due to the influence of soil and environmental factors, it improves physical, chemical and biological properties of soil, and the released nutrients can be used for growing crops (Risse *et al.,* 2001). This indicates that organic amendment is an integral part of soil productivity and sustainable agriculture. Among different natural and available sources of poultry manure, organic materials has long been known the appropriate one due to its high N, P and K content. Organic nitrogen in chicken manure is readily available in range of 30-50% (Nicholson *et al.,* 1996).

Molybdenum is an essential micronutrient for plants, animals and bacteria. It is directly related to reductase that reduces the nitrate to nitrite which is the first way towards incorporation of N to protein, It is also out as a co-factor of nitrogenase which is responsible for biological nitrogen fixation, as the deficiency & N-fixation (Bambara and Ndakidemi, 2010). Mg on the other side is an important nutrient for plant growth and play an essential role in photosynthesis (Mg is the central mineral element of the chlorophyll molecule) starch translation, sugar synthesis, formation of plant facts & oils, nutrient uptake control and aid nitrogen fixation in legume nodules. It is also an enzyme activator, a part of many enzymes and barrier of P the plants (Marschner, 1995; Allison *et al.,* 2001).Smith *et al.* (1992) stated that commercial foliar fertilizers when applied in low soil moisture are rapidly absorbed through foliar way and therefore it enhance the crop yield and quality. Salim (1992) investigated that foliar spray of 1% urea significantly raise the growth rate of soyabean. Torun *et al.* (2001) reported that foliar application of micronutrients is more effective to control the deficiency problem than soil applications. Latha and Nadanassababady (2003) reported that in pulse foliar spray of N at a particular phase may solve the slow growth and low seed yield without interfering root absorption at critical stage.

Several studies were reported dealing with the role of Mg or Mo on the production of vegetable crops (Elkhatib, 2009; Chahal and Chahal, 1991; Allison *et al.,* 2001). However the interaction between N, Mg, and Mo has not been previously reported. Due to that purpose the present study was proposed to check the cauliflower curd yield response against the nitrogen fertilizer in both basal and foliar form and in combination with micronutrients (Mg and Mo) under poultry manure condition.

Materials and methods

Experimental site and design

A field trial was proposed to examine the effect of nitrogen fertilization on growth and yield of cauliflower in poultry manure treated soil during 2012 at farmer's field Marghazar, Mansehra. The experiment was laid out in Randomized Complete Block Design (RCBD) with five treatments and replicated three times. The experiment was comprised of 15 plots and each plot area was 2.5m x 2.5m.

Experimental treatments

Poultry manure was applied with a rate of 1953 kg ha^{-1} to the experimental field before transplantation of cauliflower (Table 2.) Khalil *et al.,* (2005); Kogram *et al.* (2002).

Basal treatments of urea and poultry manure was

done single time while the foliar spray of 'N' was revised four times each after interval of 15 days. The experiment was comprised of the following treatments;

- ✓ T_0= Control (Urea) 123.5 kg ha^{-1}.
- ✓ T_1= N + Mo + Mg foliar spray (4% N + (Mo) 50 mg L^{-1} + (B) 80 mg L^{-1}).
- ✓ T_2= Urea 123.5 kg ha^{-1} + 2%N
- ✓ T_3= Nitrogen foliar spray 4% N.
- ✓ T_4= Nitrogen foliar spray 8% N.

Soil physiochemical analysis

From the experimental area before sowing soil samples were randomly taken from 0-10cm and 10-20cm depth for physiochemical analysis (Table. 1). pH meter was used to measure soil pH (McLean, 1982). Macro-Kjedahl method was used to analyze nitrogen (Paul and Berry, 1921). Both phosphorus and potassium was analyzed through Ammonium bicarbonate-Diethylen triamin penta acetic acid (AB-DTPA) method (Soltanpour and Woekman, 1979).

Experimental traits

Ten plant samples were randomly chosen from each experimental plot to record the following growth and yield parameters viz. number of leaves $plant^{-1,}$ leaf length, leaf width, root length, root fresh weight, root dry weight, plant aerial part, plant height, plant weight, curd weight, curd circumference and curd yield.

Statistical analysis

All these recorded parameters data was analyzed statistically by software SPSS 16.0. Mean differences among treatments were calculated by using LSD test ($p<0.05$).

Results and discussion

Growth parameters

Table. 3 revealed that number of leaves $plant^{-1}$ is non-significant, while significant from control, Basal applied urea + 2%N spray produced maximum number of leaves $plant^{-1}$ and minimum by basal treatment of urea. Leaf length was non-significant among N + Mo + Mg combined foliar spray and foliar spray 8% N, while significant from other treatments. Leaf width was non-significantly different among N + Mo + Mg combined foliar spray and basal applied urea + 2%N spray treatment while both the treatments were significantly different from other treatments (Fig 1).

Table 1. Soil physiochemical characteristics of experimental area at farmer's field Marghazar, Mansehra.

S.no	Sample Id	NO_3-N (mg/kg)	P (mg/kg)	K (mg/kg)	pH	EC (dSm^{-1})
1.	(0-10 cm)	2.41	1.12	165	7.17	0.31
2.	(10-20 cm)	1.83	0.91	129	7.61	0.49

Results for root length, root fresh and dry weight was significantly different between treatments, maximum root length was produced by combine foliar spray of N + Mo + Mg while highest root fresh and dry weight was due to foliar spray 8% N, minimum value for all these three traits was recorded due to basal treatment of urea (Table 3 &Fig. 2).

Aerial part height and plant height both the traits showed significant results. Highest aerial height and plant length was attained by foliar spray 8% N, while minimum was scored by basal treatment of urea. Basal applied urea + 2%N spray for both traits also showed significance in comparison with all remaining treatments (Table 3 & Fig. 3). Our results are in agreement with Clecko *et al.* (2000); Awad and El-Ghamry (2007) who reported that increase in the cauliflower vegetative growth was due to the use of Mg foliar spray which may be attributed to its role like it converts light energy into chemical energy, essential for photosynthesis and the central atom for chlorophyll molecule. Table 2 showed that maximum

plant weight (2.470 kg) was due to combine foliar spray of N + Mo + Mg, while basal treatment of urea showed minimum plant weight (0.656 kg). Foliar spray 8% N and foliar spray 4% N showed (2.313 kg and 2.398 kg, respectively). Similar results were reported by Caser (2009) that highest leaves weight plant^{-1} (2350 g) in cauliflower was due to 30mg L^{-1} GA 3 and same treatment dose also produced maximum number of leaves plant^{-1} 35 and 32, respectively. These results are in agreement with the findings of Elkhatib, (2009) on common bean, Chahal and Chahal (1991) on pea.

Table 2. Chemical and biochemical properties of poultry manure.

S.no	Chicken manure type	pH	%N	%P	%K	%Lignin
1	manure Fresh chicken	7.8	2.16	1.12	1.64	7.2
2	manure Small pellet chicken	7.6	2.39	0.46	2.02	-
3	manure Large pellet chicken	7.3	3.74	0.54	2.50	-

Table 3. Mean comparison response of cauliflower vegetative traits to different nutrients application.

Treatments	Leaves plant^{-1}	Leaf length (cm)	Root length (cm)	Width of Leaf (cm)	Plant aerial part (cm)	Plant height (cm)	Root fresh weight (g)	Root dry weight (g)	Plant weight (kg)
T_0	14c	41.6c	12.4c	13.2c	49.4d	61.8c	20d	8d	0.656e
T_1	18a	71a	17.8a	28.2a	71.2b	89a	80b	31b	2.470a
T_2	19a	64.2b	12.6c	28.8a	67bc	79.6b	86b	37ab	2.313bc
T_3	18a	59.4b	12.2c	23.4b	64c	76.2b	58c	23c	1.602d
T_4	17b	69a	15.4b	24.2b	76.4a	91.8a	98a	44a	2.398b

Within each column, treatments carry same superscript letter are not significantly different at 5% level.

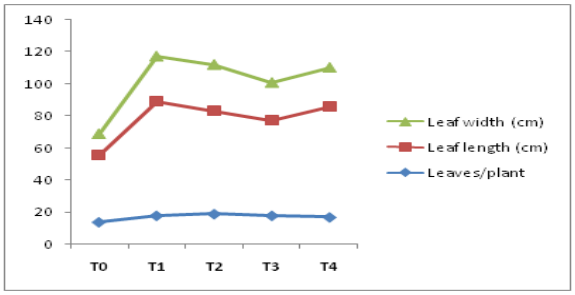

Fig. 1 Response of cauliflower leaf traits to different nutrients application.

Yield and yield parameters

Table. 4 and Fig. 6 revealed that maximum curd weight (1174 g) was recorded due to N + Mo + Mg foliar treatment, basal applied urea + 2%N spray treatment also showed significant results from rest of the treatments while minimum curd weight (431 g) was noticed in basal treatment of urea. Same results were recorded for curd circumference (55.2cm) that highest curd circumference was due to N + Mo + Mg foliar treatment, basal applied urea + 2%N spray showed 2nd best value (54cm) while minimum curd circumference (35.8cm) was recorded in urea basal placement (Fig. 4).

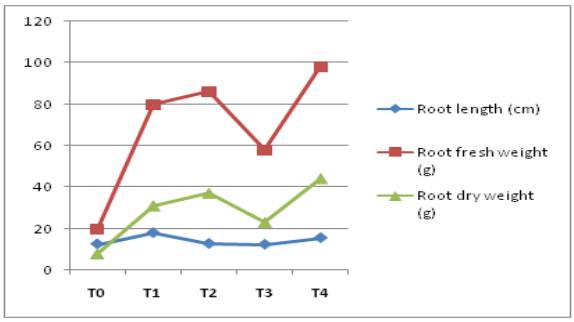

Fig. 2 Response of cauliflower root traits to different nutrients application.

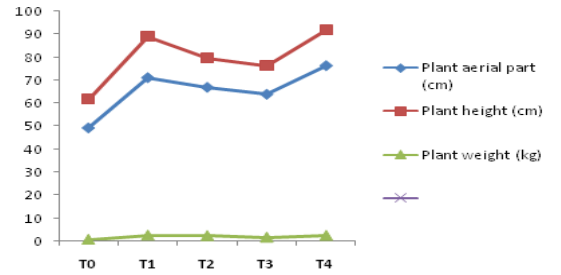

Fig. 3. Response of growth traits to different nutrients application.

Table 4 and Fig. 5 showed that maximum yield (17.960 kg) was recorded by the treatment of N + Mo + Mg foliar spray while minimum yield (7.758 kg) was noticed by basal treatment of urea. Basal applied urea + 2%N spray and foliar spray 4% N treatment yielded 17.334 kg and 14.428 kg, respectively. Matching results were discussed by Ahmad *et al.* (2011) who reported that Mo spray at 30 and 45 µg/l in combination with Mg at 0.50 and 0.75% in both seasons showed best yield. Similar results were obtained by Rahman *et al.* (2014) who reported that foliar application of NPK showed the maximum grain yield (813kg/ha), followed by DAP and poultry manure.

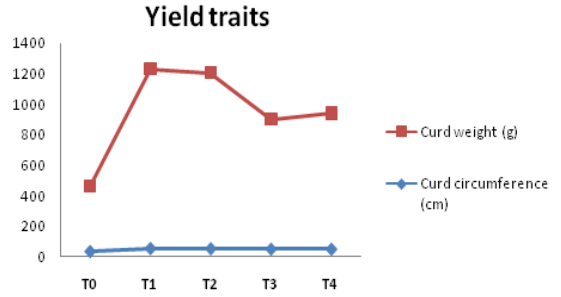

Fig. 4. Response of cauliflower yield traits to different nutrients application.

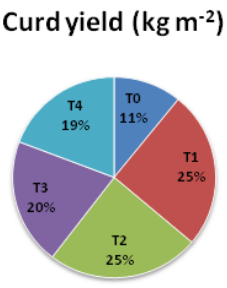

Fig. 5. Response of cauliflower curd yield to different nutrients application.

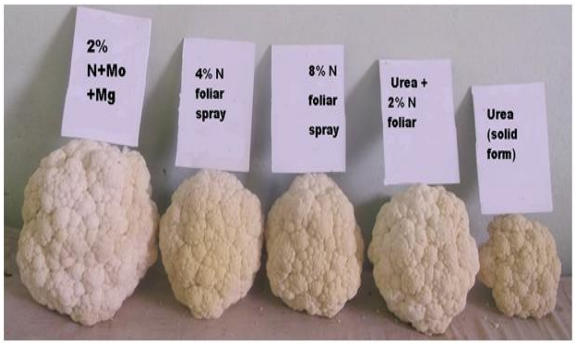

Fig. 6. Response of cauliflower curd to different nutrients application.

Conclusion

From these results it could be suggested and recommended that nitrogen in combination with micronutrients (Mo and B) are the most essential plant mineral nutrients in foliar fertilization method for growth and curd yield of cauliflower under poultry/chicken manure condition.

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