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Effect of Foliar Application of Vegetable Special on Growth and Yield of Potato

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A B S T R A C T

An on farm testing on effect of foliar application of vegetable special on growth and yield of potato was conducted in farmers' field of Hassan district in five locations during 2015 and 2016 through Krishi Vigyan Kendra, Kandali, Hassan, University of Agricultural Sciences, Bengaluru. The results of the two years pooled data (2015 and 2016) revealed that foliar applications of vegetable special @ 5g/lit recorded significantly higher yield (103.95q/ha) and the lowest yield was recorded in farmers practice (91.3q/ha). However foliar application of vegetable special @ 3g/lit (98.1q/ha) was on par with recommended practice (95.1q/ha). The increase in yield was 13.85 percent with foliar application of vegetable special @ 5g/lit along with recommended dosage of fertilizer compared to farmers practice. Recommended practice and alternate practice-1 recorded 5.96 percent and 9.07 percent increase in yield compared to farmers practice. The similar trend was observed with respect to yield parameters of potato. However, significantly higher number of tubers and tuber weight was recorded with RDF+ foliar spray of vegetable special @ 5g/lit (9.7 and 1.46 kg) compared to farmers practice (4.5 and 0.62kg). Lowest number of tubers per plant and tuber weight was recorded in farmers' practice (4.5 and 0.62). However similar number of tubers and tuber weight was recorded with recommended practice (5.6 and 0.81kg and alternate practice-2 (7.7 and 1.18kg). The maximum total number of tubers were recorded in alternate practice-2 (107.35) followed by alternate practice-1 (102.0). However, number of tubers per square meter was on par with farmers' practice (90.67) and recommended practice (97.9). As regard to micronutrient content in tubers higher concentration of Zn, Cu, Mn, Fe, B and Mo were recorded in the treatment where foliar application of vegetable special @ 5g/lit along with RDF (22.2, 8.3, 21.5, 25.0 and 16.6) than recommended practice and farmers practice. With respect of economics of crop the higher B: C ratio was recorded with Alternate practice-2 + RDF (1:2.44) followed by alternate practice-1 (2.30) and recommended practice (2.26). The lowest B: C ratio was recorded in Farmers practice (2.23).

Introduction

Potato (*Solanum tuberosum*) is one of the main tubers and nutritious crops, which also is very important due to nutritive value and economical. Potato is a very popular vegetable grown all over the world and is an important food crop grown in more than 150 countries in the world. Potato popularly known as 'The king of vegetables' has emerged as fourth most important food crops in India after rice, wheat and maize. Indian

agricultural production heavily depends on fertilizer application which results in greater rate of nutrient collapse and soil health problems. Regular depletion of nutrient resources from soils has led to emergence of several nutrient deficiencies. Most of the Indian soils are widely deficient in micronutrients especially Zn, Mn, B and Fe. In most of the productive bowls of the world the yield levels of different crops are showing declining trends in spite of addition of sufficient quantity of fertilizers carrying macro and micronutrients. The efficiency of applied inorganic micronutrients is rather low due to their fixation in the soil.

It is noticed that high yielding crop varieties are mining our soils of all the nutrients especially the micronutrients because their addition as fertilizer element is negligible. Iron and manganese are involved in metabolic processes and these are considered activators of important enzymes (Mengal and Kirkby, 1987). Iron is also a structural component of haemoglobin and cytochrome (Tisdale *et al.*, 1985). Potato has been categorized as less sensitive to Fe deficiency (Rashid and Din. 1992), while moderately sensitive to Mn toxicity (Lucas and Knezek, 1972). One of the most important issues about increase of crop yield and improving the quality of agricultural products is balanced plant nutrition. Foliar application of nutrients has become an efficient way to increase yield and quality of crops (Romemheld and El-Fouly, 1999). It is evident from the researcher that the yield levels of potato declining mainly due to deficiency of micronutrient in soil and plant.

Materials and Methods

An on farm testing on effect of foliar application of vegetable special on growth and yield of potato was conducted in farmers field of Hassan district through Krishi Vigyan Kendra, Kandali Hassan, University of Agricultural Sciences, Bengaluru during kharif season of 2015 and 2016. The experiment was laid out in randomised block design (RBD) with 4 treatments replicated 5 times (at 5 locations). The soils of experimental sites were sandy clay loam in texture and the initial physic-chemical properties of experimental sites were analysed using standard procedures (Jackson, 1973) (Table 1). The treatments were imposed in farmers' field in five locations as per the treatment details given below.

T1: Farmers practice (100:90:26 NPK kg/ha)

T2: Recommended Practice (75:75:100 NPK kg/ha)

T3: RDF+ Foliar spray of Vegetable special @ 3g/lit

T4: RDF+ Foliar spray of Vegetable special @ 5g/lit

Composition of vegetable special

The vegetable special contains 3.0 percent zinc, 0.5 percent boron, 1.0 percent Manganese, 2.0 percent iron and 0.1percent copper

The crop with variety Kufri Jyothi was sown in plots with row to row distance of 60 cm and plant to plant distance of 20 cm. The growth parameters were recorded at 60 DAS and 90DAS and yield parameters recorded at harvest. The data were analysed statistically by following standard procedures.

Results and Discussion

Growth parameters

Results of pooled data of 2015 and 2016 revealed that at 60 DAS the growth parameters like plant height and number of branches were increased significantly due to foliar spray of vegetable special @ 5g/lit

along with RDF (36.05 cm and 4.65) over farmers practice (39.25 cm and 3.10). Foliar application of vegetable special @ 3g/lit (37.6 cm and 4.25) and recommended practice (40.3 cm and 3.25) recorded similar results and were on par with each other. The similar trend was followed at 90 DAS with respect to plant height and number branches during both the years and in pooled data. The increase in growth parameters like plant height and number of branches in alternate practice was due to influence of foliar application of micronutrient which enhanced growth and development of crop. These results are in agreement with findings of Mohamadi (2000) (Table 2).

Yield and yield parameters

The yield and yield parameters differed significantly due to foliar application of vegetable special over other treatments. Results of the pooled data revealed that significantly higher number of tubers per plant and tuber weight per plant was recorded due to foliar application of vegetable special @ 5g/lit along with RDF(9.7 and 1.46 kg) over farmers practice (4.5 and 0.62) and recommended practice (5.6 and 0.81). However, recommended practice and alternate practice-1(7.7 and 1.18 kg) were on par with each other with respect to number of tubers per plant and tuber weight per plant. Several researches indicated a positive influence of micronutrient (Zn, Mn) application in increase of yield and quantitative parameters of crops (Mosavi *et al.,* 2007) on potato, (Paygozar *et al.,* 2009) on pearl millet As regard to tuber yield per hectare, significantly higher tuber yield of potato per hectare was recorded in alternate practice-2 (103.95q/ha) over other treatments.

Significantly lowest tuber yield was recorded in the farmers practice (91.3q/ha) than other treatments. Similar yield levels recorded in recommended practice (95.3q/ha) and alternate practice -1 (98.1q/ha) and were on par with each other. The increase in yield was 13.85 percent in alternate practice over farmers. However percent increase in yield was decreased by 9.07 and 5.96 percent when compared to recommended practice and alternate practice, respectively. Increase in tuber yield per hectare was due to quick compensation of micronutrient through foliar application has satisfied plant demand for micronutrient which helped in better tuberization in turn increased tuber yield. Similar results were also recorded by Horvat *et al.,* (2014) and Mehulparmar (2016) (Table 3).

Table.1 Initial physico-chemical properties of experimental site

S. No.	Parameters	Value	References
1	pH	6.8	M.L. Jackson(1965)
2	EC(ds/m)	0.23	
3	Organic Carbon (%)	0.58	
4	Available Nitrogen(kg/ha)	312.5	
5	Available Phosphorus (kg/ha)	65.5	
6	Available Potassium (kg/ha)	178.6	
	Micronutrient status (DTPA Extractable) in ppm		
7	Zinc	0.65	CA Black (1973)
8	Copper	0.45	
9	Manganese	0.29	
10	Iron	4.58	
11	Boron	0.22	
12	Molybdenum	0.10	

(Mean of five farmers in the same location.)

Table.2 Effect of foliar application of vegetable special on growth parameters of potato (*Solanum tuberosa*)

S. No.	Treatments	Plant height (cm)						Number of branches /plant					
		60 DAS			90 DAS			60 DAS			90 DAS		
		2015	2016	Pooled	2015	2016	Pooled	2015	2016	Pooled	2015	2016	Pooled
1	Farmers practice(100:90:26 kg/ha NPK)	38.5	40.0	39.25	55.6	52.5	54.05	3.0	3.2	3.10	3.4	3.8	3.6
2	Recommended practice (75:75:100 NPK kg/ha)	39.6	41.0	40.3	62.5	63.4	62.95	3.5	3.0	3.25	4.5	5.2	4.8
3	Alternate Practice -1 RDF+ Foliar spray of vegetable special @ 3g/lit	38.5	36.7	37.6	63.0	62.5	62.75	4.0	4.5	4.25	4.8	5.5	5.1
4	Alternate Practice -1 RDF+ Foliar spray of vegetable special @ 5g/lit	36.6	35.5	36.05	62.8	63.4	63.10	4.5	4.8	4.65	5.8	6.2	6.0
	CD (at 5%)	**0.42**	**0.45**	**0.39**	**0.33**	**0.54**	**0.43**	**0.39**	**0.51**	**0.45**	**0.60**	**0.62**	**0.61**
	SEM	**0.14**	**0.15**	**0.13**	**0.11**	**0.18**	**0.14**	**0.13**	**0.17**	**0.15**	**0.20**	**0.22**	**0.21**
	CV (%)	**5.20**	**5.45**	**5.32**	**8.52**	**6.52**	**7.52**	**16.6**	**22.13**	**19.36**	**19.32**	**16.26**	**17.79**

Table.3 Effect of foliar application of vegetable special on yield parameters of potato

S. No.	Treatments	Number of Tubers/plant			Tuber weight /plant (kg)			Tuber yield(q/ha)			% increase in yield
		2015	2016	Pooled	2015	2016	Pooled	2015	2016	Pooled	
1	Farmers practice	4.8	4.20	4.5	0.56	0.69	0.62	88.2	94.5	91.3	-
2	Recommended practice	6.2	5.0	5.6	0.78	0.85	0.81	95.8	94.8	95.3	9.07
3	Alternate Practice -1 RDF+ Foliar spray of vegetable special @ 3g/lit	7.5	8.0	7.7	1.11	1.25	1.18	98.6	97.6	98.1	5.96
4	Alternate Practice -1 RDF+ Foliar spray of vegetable special @ 5g/lit	10.0	9.4	9.7	1.45	1.48	1.46	105.4	102.5	103.95	13.85
	CD (at 5%)	**0.98**	**0.81**	**0.89**	**0.06**	**0.09**	**0.075**	**3.34**	**2.40**	**2.87**	
	SEM	**0.308**	**0.26**	**0.284**	**0.02**	**0.03**	**0.025**	**1.14**	**0.84**	**1.00**	
	CV (%)	**19.83**	**17.45**	**18.64**	**12.49**	**14.01**	**13.25**	**5.22**	**3.82**	**4.52**	

Table.4 Effect of foliar application of vegetable special on micronutrient content in potato tubers

S. No.	Treatments	Micronutrient content in Potato tubers (ppm)														
		2015					2016					Pooled				
		Zn	Cu	Mn	Fe	B	Zn	Cu	Mn	Fe	B	Zn	Cu	Mn	Fe	B
1	**T1:Farmers practice**	15.2	5.5	14.5	18.5	12.0	16.2	6.2	15.6	19.5	13.0	15.7	5.85	15.05	19.0	12.5
2	**T2:Recommended Practice**	16.4	6.4	17.2	19.5	13.5	17.0	6.8	18.8	22.0	14.2	16.7	6.6	18.0	20.7	13.8
3	**T3:Alternate Practice-1**	18.5	7.4	18.2	21.6	14.6	19.4	7.2	19.7	24.5	15.2	18.9	7.30	18.9	23.0	14.9
4	**T4:Alternate Practice-2**	22.6	8.2	20.5	24.5	16.5	21.8	8.4	22.5	25.6	16.8	22.2	8.30	21.5	25.0	16.6
	CD (at 5%)	**2.22**	**1.25**	**2.25**	**2.85**	**1.45**	**2.16**	**1.30**	**2.18**	**2.75**	**1.52**	**2.19**	**1.27**	**2.21**	**2.80**	**1.48**
	SEM	**0.71**	**0.41**	**0.75**	**0.95**	**0.54**	**0.75**	**0.48**	**0.72**	**0.91**	**0.52**	**0.73**	**0.44**	**0.73**	**0.93**	**0.53**
	CV (%)	**5.67**	**6.25**	**6.40**	**6.05**	**5.47**	**6.25**	**5.50**	**6.8**	**4.78**	**6.81**	**6.02**	**5.87**	**6.60**	**5.41**	**6.14**

Table.5 Effect of foliar application of vegetable special on economics of crop

S. No.	Treatments	Gross Return (Rs/ha)			Net Return (Rs/ha)			B: C ratio		
		2015	2016	Pooled	2015	2016	Pooled	2015	2016	Pooled
1	**T1:Farmers practice**	1,36,950	141750	137025	71800	79750	75775	2.19	2.28	2.23
2	**T2:Recommended Practice**	1,42,950	142200	142950	80900	79100	80000	2.28	2.25	2.26
3	**T3:Alternate Practice-1**	1,47,150	147150	1478525	84200	82950	83575	2.32	2.29	2.30
4	**T4:Alternate Practice-2**	1,55,925	153750	155925	94600	89950	92275	2.48	2.40	2.44

Table.6 Effect of foliar application of vegetable special on number of tubers per 10 square meter

Particulars	T-1 Farmers practice			T2-Recommended Practice			Alternate practice-1			Alternate practice-2		
Tuber size /number	2015	2016	Pooled	2015	2016	Pooled	2015	2016	Pooled	2015	2016	Pooled
<25 g	96.0	98	97	112.5	113.0	112.75	118.0	117.5	117.75	**122.0**	124.0	123
25-50 g	145.5	146.0	145.75	159.0	162.0	160.5	164.5	166.0	165.25	**175.7**	178.0	176.85
50-75 g	287.2	290.0	288.6	312.5	314.5	313.5	325.0	328.0	326.5	**350.3**	352.0	351.15
>75 g	378.0	275.0	326.5	395.0	392.0	393.5	412.5	415.0	413.75	**425.5**	428.0	426.75
Total number of tubers /10sqmt	906.7	809	857.85	979	981.5	980.25	1020	1026.5	1023.25	1073.5	1082	1077.75

Number of tubers per 10 square meter

Number of tubers per square meter differed among the treatments. The maximum total number of tubers were recorded in alternate practice-2 (1073, 1082 and 1077.7) during both the years and in pooled data and however was on par with alternate practice-1 (1020, 1026 and 1073.5) during both the years and in pooled data. The lowest number of tuber per 10 square meter was recorded in farmers practice during 2015, 2016 and in pooled data (906, 809 and 857.85) and was on par with farmers and recommended practice which recorded 979, 981.5 and 980.25 tubers per 10 square meter. The higher number of tubers per 10 square meter was recorded due to combined effect of integrated management of both macro (NPK) and micronutrient (Zn, Cu, Mn, Fe and B) in turn increased the number of tubers by 25 percent over farmers practice. These results are in agreement with findings of Mousavi *et al.,* (2007). With respect size of tubers, maximum tubers recorded with more than 75gm of tuber in alternate practice-2 (426.75) followed by alternate practice-1, (413.75) recommended practice (393.5) and farmers practice (326.5). Similar trend was also followed with respect other size groups like <25g, 25-50g and 50-75 g (Table 6).

Micronutrient content in potato tubers

As regard to micronutrient content in tubers higher concentration of Zn, Cu, Mn, Fe, B and Mo were recorded in the treatment where foliar application of vegetable special @ 5g/lit along with RDF (22.2,8.3,21.5,25.0 and 16.6 ppm) than recommended practice and farmers practice. These results are in agreement with findings of Malakouti (1999) (Table 4).

Economics of crop

As regard to economics of crop, the highest gross return was recorded in alternate practice-2 (Rs 1,55,925, 1,53,750 and 1,55,925) during 2015, 2016 and in pooled data over farmers practice (Rs. 1,36,950, 1,41,750 and 1,37,025) during both the years and in pooled data. Similarly the Net return was increased by Rs 92,475 compared to farmers practice (Rs 76,450). However in recommended practice and in alternate practice there was no much difference noticed and recorded net income of Rs 80,150 and Rs 83850 per hectare respectively. However increase in additional income of Rs. 16,500 was recorded compared to farmers practice (Table 5).

With respect of Economics of crop the higher B: C ratio was recorded with Alternate practice-2 + RDF (1:2.44) followed by alternate practice-1 (2.30) and recommended practice (2.26). The lowest B: C ratio was recorded in Farmers practice (2.23).

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