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YIELD POTENTIAL OF ONION AS INFLUENCED BY SOIL TEST BASIS NUTRIENT MANAGEMENT

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ABSTRACT

Farmer's perception of nutrient management for onion bulb production often ignores the soil test basis (STB) which provides essential base line information on the nutrient status of soils. A field experiment on onion (cv. BARI Piaj-4) was conducted during three consecutive years 2016-17, 2017-18 and 2018-19 at the research field of Spices Research Centre (level Barind Tract, AEZ 25), BARI, Shibganj, Bogura, Bangladesh to determine the optimum doses of Nitrogen (N), Phosphorus (P), Potassium (K), Sulphur (S), Zinc (Zn) and Boron (B) for maximization of bulb yield of onion. The experiment was arranged in a Randomized Complete Block Design (RCBD) with three replications having six different levels of fertilizer doses i.e. T_1 (Control), T_2 (STB dose), T_3 (STB + 15% extra of STB), T_4 (STB + 30% extra of STB), T_5 (STB + 45% extra of STB) and T_6 (Farmer's practice). The nutrient management treatments positively influenced plant height, leaf length, number of leaves plant^{-1}, bulb diameter, marketable yield and total yield per hectare. The best results with regard to number of leaves plant^{-1} (5.98), bulb length (7.21 cm), bulb diameter (5.52 cm), single bulb weight (43.07g) and bulb yield (19.83 tha^{-1}) were obtained from the treatment T_5. Considering the yield contributing parameters in onion production, the most suitable nutrient management package was STB + 45% extra of STB but the highest marginal benefit cost ratio (7.60) was obtained in T_2 (STB dose). N, P, K, S, Zn, B doses of 120, 54, 78, 30, 4.2, 1.5 kg ha^{-1}, respectively is recommended for maximum onion bulb production in this location.

Key words: Yield, onion, nutrient.

Introduction

Onion (*Allium cepa* L.) is one of the most important spices as well as vegetable crops in Bangladesh. The crop was originated somewhere between western China and deserts lying east of the Caspian Sea (Jones and Mann, 1963). In Bangladesh, the area of onion is 1.76 lakh hectare and the total production is 17.35 lakh metric tons with an average yield of 9.86 t/ha (BBS, 2018) which is low compared to several major onion growing countries. The average yield of onion in the USA is 41.12 t/ha and India is 12.5 t/ha. At present the shortage of onion in Bangladesh is about 8-9 lakh metric tons per year. So, huge amount of onion is needed to import in each year to meet up the demand investing foreign currency. Nutrients supplied in the form of fertilizers are one of the most important inputs for increasing the productivity of onion crops (Anon., 1997). In order to obtain good yield, high responsive modern varieties of the onion crop require relatively high quantity of fertilizer compared to the traditional cultivars. Generally farmers in Bangladesh use a higher amount Nitrogen (N), Phosphorus (P), Potassium (K), Sulphur (S), Zinc (Zn) and Boron (B) fertilizers for onion bulb production at Meherpur, Chittagong and Rajshahi regions. The current average dose of these nutrients in a representative farmers field is N=345, P=150, K=135 kg/ha supplied from fertilizers, which is much higher than the general recommended dose (N=120, P=54, K=75 kg/ha). Moreover, the socio economic conditions of the farmers and benefit cost scenario of fertilizer usage are often ignored during nutrient dose recommendation. So, the present study has been designed to evaluate the response of onion to higher doses of nutrients and to determine the profitability of the same.

Materials and Methods

The experiment was carried out at the research field of Spices Research Centre, Shibganj, Bogura, Bangladesh during three consecutive years 2016-17, 2017-18 and 2018-19 to determine the optimum dose

of fertilizer for maximization of bulb yield of onion. The experimental site situated at 24°51′ N latitude and 89°22 E longitudes belongs to the AEZ-25, level Barind Tract (Fig. 1). It has sub-tropical climate with an average annual rainfall of 1762 mm. The experiment was laid out in a randomized complete block design (RCBD) with three replications. BARI Piaz-4 was used as the test materials in this trial. Composite soil samples (0-15 cm depth) were collected from the selected fields for determining the initial nutrient status of soil. The analytical results of the initial soil samples from the experimental plots are presented below:

Table 1. Analytical value of the experimental soil during 2018-2019

Texture	pH	OM	Ca	Mg	K	Total N	P	S	B	Zn	Cu
		%	(meq/100g soil)			%	(ug/g soil)				
Clay loam	5.6	1.02	2.4	0.93	0.33	0.06	15.2	8.3	0.13	1.25	0.12
Critical limit	-	-	2.0	0.8	0.20	-	14	14	0.2	0.6	0.2

Fig 1. Showing experimental plots

The unit plot size was 3 m x 2.5 m. One-third of N and whole amount of PKSZnB were applied at the time of final land preparation in the form of Urea, Triple super phosphate, muriate of potash, Gypsum, Zinc sulphate and Borax respectively. The remaining 2/3rd urea were applied in two equal installments during 3rd and 5th week after transplanting as top dress.

Table 2. Treatment description and nutrient rates used in the field experiment

Treatments	Nutrient rate (kgha^{-1})					
	N	P	K	S	Zn	B
T_1= Control	0	0	0	0	0	0
T_2= STB dose	120	54	78	30	4.2	1.5
T_3= STB + 15% extra of STB	138	62	90	34.5	4.8	1.73
T_4= STB + 30% extra of STB	156	70.2	101.4	39	5.46	1.95
T_5= STB + 45% extra of STB	174	78.3	113	43.5	6.09	2.18
T_6= Farmer's practice	345	150	135	20	-	-

STB= Soil Test Basis

Onion seedlings of 45 days old were transplanted on 15 December, 2018. The row-to-row and plant-to-plant spacing were 10 cm and 10 cm, respectively. Weeding and mulching were done as and when necessary to keep the crop free from weeds and to pulverize the soil. The young plants were irrigated by water cane. Three-irrigations were given during the cropping period. For the prevention of cutworm *(Agrotis ipsilon)* soil treatment was done with Furadan 3G @ 20 kgha^{-1}. Purple blotch disease was controlled by spraying Rovral 50 WP and Amister Top, respectively in due time. Bolting was discouraged

by nipping off the flower stalks whenever they appeared during the growing period of the crop. The crop was harvested on 6 April 2019 when 80% of the plants showed the sign of maturity by drying out most of the leaves and they collapsed at the neck of the tops. The plant height and number of leaves plant^{-1} was recorded from randomly selected ten plants collected from each unit plots during maximum vegetative stage. The yield attributes of onion were recorded from the randomly selected ten plants collected from each unit plots during harvest. The bulb yield was taken plot-wise and thereafter converted into ton per hectare. Data were analyzed using R statistical software (http://www.R-project.org). Data of yield and yield contributing traits were analyzed by analysis of variance (the agricolae R package and aov function; De Mendiburu, 2017).

Results and Discussion

The yield and yield contributing characters of onion varieties differed significantly due to different fertilizer combinations (Table 3). The highest plant height (53.24 cm) was recorded from the treatment T_6 (Farmer's practice) which was statistically similar to T_5 (STB + 45% extra of STB). The highest number of leaves plant^{-1} (5.98), bulb length (7.21cm), bulb diameter (5.52cm) and single weight of bulb (43.07g) was recorded from the treatment T_5(STB + 45% extra of STB). The lowest plant height (43.00 cm), number of leaves plant^{-1} (3.72), bulb length (4.00cm), bulb diameter (3.10cm) and single weight of bulb (14.53g) was noted from the control treatment. The effect of nutrient on bulb yield of onion is shown in Fig. 2.

Table 3. Yield and yield contributing characters of onion (pooled data of 3 years)

Treatments	Plant height (cm)	No. of leaves plant^{-1}	Bulb length (cm)	Bulb diameter (cm)	Single Bulb Weight (g)
T_1= Control	43.00d	3.72e	4.00c	3.10d	14.53d
T_2= STB dose	48.60b	5.52bc	6.95b	4.93bc	33.68c
T_3= STB + 15% extra of STB	47.13bc	5.42bcd	7.01ab	5.25ab	39.72b
T_4= STB + 30% extra of STB	48.20b	5.52bc	6.97 ab	5.06bc	38.08b
T_5= STB + 45% extra of STB	52.33a	5.98a	7.21a	5.52a	43.07a
T_6= Farmer's practice	53.24a	5.72b	7.15a	5.42a	42.01ab
Level of Significance	**	**	**	**	**
CV (%)	4.98	5.86	6.65	7.85	9.18

In a column, means followed by the same letters did not differ significantly. **= 1% level of significance, ns= Non significant, CV= Coefficient of variation

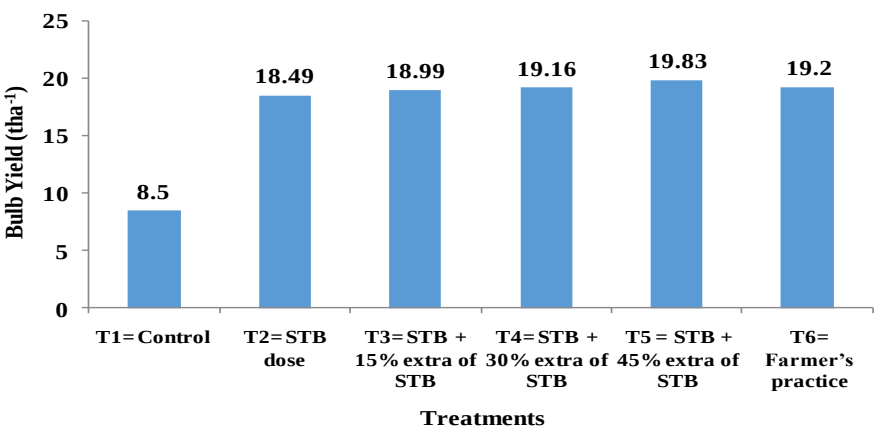

Fig. 2. Effect of different treatments on bulb yield of onion

Economic analysis of different treatments: The economic analysis of different treatments has been presented in Table 4. It was noted that the expenses incurred here referred to those only on fertilizer cost. It was revealed that the highest marginal benefit cost ratio (7.60) was also calculated from T_2 (STB dose). The lowest marginal benefit cost ratio 2.88 was obtained from T_6 (Farmer's practice) treatment. So considering MBCR, T_2 (STB dose, $N_{120}P_{54}K_{78}S_{30}Zn_{4.2}B_{1.5}$ kgha^{-1}) may be recommended for highest onion bulb production.

Table 4. Cost and return analysis of onion as affected by different fertilizer levels

Treatments	BulbYield (tha^{-1})	Gross return (Tk ha^{-1})	Cost of treatment (Tk ha^{-1})	Net return (Tk ha^{-1})	Adjusted net return (Tk ha^{-1})	MBCR
T_1= Control	8.5	127500	0	127500	-	-
T_2= STB dose	18.49	277350	17410	259940	132440	7.60
T_3= STB + 15% extra of STB	18.99	284850	22136	262714	135214	6.11
T_4= STB + 30% extra of STB	19.16	287400	24766	262635	135135	5.46
T_5 = STB + 45% extra of STB	19.83	297450	27393	270057	142557	5.20
T_6= Farmer's practice	19.02	285300	40705	244595	117095	2.88

MBCR= Marginal benefit-cost ratio, Urea: TK.20/kg, TSP: TK.22/kg, MOP: TK.15/kg, Gypsum: TK. 10/kg, Borax: TK.100/kg, Cow dung: TK.0.5/kg, Human Labour: TK.400/man/day (fertilizer application), Onion bulb sale price: BARI Piaz-4:TK.15/kg

Conclusion

- ✓ Application of fertilizer on STB dose the highest marginal benefit cost ratio (7.60).
- ✓ The STB nutrient dose ($N_{120}P_{54}K_{78}S_{30}Zn_{4.2}B_{1.5}$ kgha^{-1}) for bulb production of onion is the best nutrient management package in AEZ-25 (Level Barind Tract).

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