

Original Research Article

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Impact of Integrated Nutrient Management on Seed Production of Onion (*Allium cepa* L.) cv. Sukhsagar

S. Tamang*, A. Bandyopadhyay, N. Chattopadhyay and D. K. Ghosh (LKN)

Department of Plantation Spices, Medicinal and Aromatic crops, Faculty of Horticulture, Bidhan Chandra Krishi Viswavidyalaya, Mohanpur- 741252, Nadia, West Bengal, India

*Corresponding author

ABSTRACT

An experiment was carried out at Horticultural Research Station, Mondouri, Bidhan Chandra Krishi Viswavidyalaya, Nadia, during *Rabi* season of 2017-18 and 2018-19. The onion cultivar “Sukhsagar” was taken under the study. Three levels of nitrogen (100, 125, 150 kg ha⁻¹), one level of phosphorus (80 kg ha⁻¹) and three levels of potassium (80, 100, 120 kg ha⁻¹) along with FYM @ 5 t ha⁻¹ were included in the investigation. There were altogether 9 treatments *viz.* T₁ - N₁₀₀P₈₀K₈₀ + FYM @ 5 t ha⁻¹, T₂ - N₁₂₅P₈₀K₈₀ + FYM @ 5 t ha⁻¹, T₃ - N₁₅₀P₈₀K₈₀ + FYM @ 5 t ha⁻¹, T₄ - N₁₀₀P₈₀K₁₀₀ + FYM @ 5 t ha⁻¹, T₅ - N₁₀₀P₈₀K₁₂₀ + FYM @ 5 t ha⁻¹, T₆ - N₁₂₅P₈₀K₁₀₀ + FYM @ 5 t ha⁻¹, T₇ - N₁₂₅P₈₀K₁₂₀ + FYM @ 5 t ha⁻¹, T₈ - N₁₅₀P₈₀K₁₀₀ + FYM @ 5 t ha⁻¹ and T₉ - N₁₅₀P₈₀K₁₂₀ + FYM @ 5 t ha⁻¹. The experiment was laid out in RBD with three replications. Among different treatments combination maximum plant height was observed with T₆-N₁₂₅ P₈₀ K₁₀₀ + FYM @ 5 t ha⁻¹ (39.73 cm), maximum number of leaves was observed with T₅-N₁₅₀ P₈₀ K₁₂₀ + FYM @ 5 t ha⁻¹ (29.35) and maximum basal girth of spike (8.05 cm) was recorded under T₈(N₁₅₀ P₈₀ K₁₀₀ + FYM @ 5 t ha⁻¹). The yield attributing parameters like maximum number of inflorescence (4.75), maximum spike length (108.01 cm), maximum umbel diameter (7.10 cm), maximum seed yield per umbel (3.55 gm), 1000 seed weight (4.55 g), seed yield per plot (300.54 g) and projected seed yield (587.06 kg ha⁻¹) were observed with T₇(N₁₂₅ P₈₀ K₁₂₀ + FYM @ 5 t ha⁻¹). From seed production maximization and B:C ratio (3.33) point of view, the most effective treatment was T₈(N₁₅₀ P₈₀ K₁₀₀ + FYM @ 5 t ha⁻¹) under new alluvial soil of west Bengal.

Keywords

B: C ratio, onion, nitrogen, phosphorus, potassium, seed yield

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Introduction

Onion (*Allium cepa* L.) the “Queen of the kitchen” belongs to family Alliaceae is one of the most important commercial vegetable cum spices crop of India as well as in the World

(Selvaraj, 1976). The outstanding characteristic of onion is its pungency, which is due to presence of a volatile oil known as allyl propyl disulphide (Yawalkar, 1985). The red colour is because of the pigment anthocyanins and yellow colour is due to quercetin (Debnath *et*

al., 2008). India is the second largest producer of onion in the world with an area of 11.73 lakh ha and production of 189.28 lakh tons next only to China with the productivity of 16.13 t ha⁻¹ a (Anon., 2016). In West Bengal onion is cultivated over an area of 25.31 thousand ha, production of 369.20 thousand MT with productivity of 14.59 t ha⁻¹ (NHB, 2015-16). It is a herbaceous annual for edible bulb production and biennial for seed production.

Seed is the primary input, without which the increase in production of any crop cannot be expected. India needs around 9400 tons of onion seeds annually (Directorate of Onion and Garlic Research). NPK fertilizers are the chemical compounds applied to promote plant growth. The application of nitrogen with different doses increased plant growth and yield of onion (Patel *et al.*, 1992). Phosphorus has its beneficial effect on early root development, plant growth, yield and quality. Potassium plays an important role in crop productivity. Keeping all the views in mind an experiment was conducted to find out the best possible combination of N, P and K along with fixed dose of FYM on seed yield of local cultivar (Sukhsagar) of onion in new alluvial plains of West Bengal.

Materials and Methods

The experiment was carried out at the HRS, Mondouri, BCKV, Mohanpur, Nadia, West Bengal during the year 2017-18 and 2018-19. The cultivar “Sukhsagar” was under taken the study. The soil at the experimental field was Gangetic alluvial with sandy clay loam texture, good water holding capacity, well drained with moderate soil fertility status and soil P^H of 6.9. The organic carbon, total nitrogen, available phosphorus and potassium contents are 0.63, 0.084 percent, 18.07 kg ha⁻¹, respectively. Treated mother bulbs were planted within second fortnight of November

each year in 2 x 2.5 m plot at 40 x 25 cm spacing. Three levels of each nitrogen (100,125,150 kg ha⁻¹), one level of phosphorus (80 kg ha⁻¹) and three levels of potassium (80, 100, 120 kg ha⁻¹) along with fixed dose of FYM @ 5 t ha⁻¹ were included in the investigation. The doses of fertilizer were adjusted with application of urea, single super phosphate and muriate of potash. There were altogether 9 treatments. All experimental plots received a uniform dose of FYM at 5 tones ha⁻¹, half dose of nitrogen, full dose of phosphorus and half dose of potash as basal and remaining half dose of each nitrogen and potash was applied after 30 days after sowing (DAS) as top dressing. Need based irrigation and eco friendly plant protection measures were under taken. Diseased and off types plants were rouged out before flowering for quality seed production. Harvesting was done during 1st fortnight of April.

The observations were recorded on ten randomly tagged plants from each plot on different growth and yield parameters like number of leaves and plant height (cm) at 60 DAS, number of inflorescence, number of spike/ plant, length of spike (cm), basal girth (cm) diameter of umbel (cm) at 90 DAS, seed weight (g per umbel), seed weight (g) per plot and projected seed yield (Kgha⁻¹) during harvesting (125 DAS). The projected yield per hectare was calculated on plot yield basis after deducting 15 percent area utilized for channel, ridges etc. Net return or profit was calculated by subtracting production cost from the gross values of the produce. Prices used for harvest products were average prices observed during the experimental period.

The benefit cost ratio (BCR) was calculated by dividing the net return by the production cost. The significance of different sources of variation was tested by error mean square by fisher snedecor’s ‘F’ test at probability level of 0.05. Statistical analysis for each variable

was conducted as per the procedure given by Gomez and Gomez (1984).

Results and Discussion

Data presented in the table 1 revealed that irrespective of any treatment and year, within the treatments influence of N, K and FYM on different growth parameters of onion better growth was observed when higher dose of N, K and FYM were applied with different combinations. Pooled data reflect that maximum plant height of 39.73cm was recorded in T₆ where N was applied in higher dose along with higher dose of K closely followed by T₃ (39.70cm). Even in year wise data also the same pattern was followed. On the other hand pooled minimum plant height (37.85cm) was recorded where dose of N and K were comparatively low (T₁). Pooled data analysis showed that in case of number of leaves per plant, T₉ recorded maximum (29.13) followed by T₃ (28.70) whereas, minimum in T₅ (23.57). In year wise data analysis it was clear that T₉ recorded maximum 28.9 and 29.35 number of leaves per plant during 2017 and 2018 respectively. Similarly, T₅ recorded minimum 22.68 and 24.45 numbers of leaves per plant during the same period of experimentation. Regarding basal girth of the spike pooled data noted that T₈ recorded maximum basal girth of 8.05cm followed by T₇ (8.0cm) which are *at par* with each other and T₄ recorded minimum basal girth of 7.0 cm. From year wise data analysis it was clear that, T₇ recorded maximum basal girth (7.85cm) and minimum basal girth (6.85cm) under T₄ during 2017. On the other hand during second year maximum basal girth (8.55cm) was recorded under T₆ and minimum (7.15cm) in T₄. The number of inflorescence per plant recorded maximum (4.75) in T₇ and minimum in T₄ (4.10) under pooled analysis. Data presented in Table -2 on yield parameters of onion like spike length, umbel diameter, seed weight per umbel, Seed weight per plot

and Projected seed yield per hectare. The maximum spike length of 108.01cm was recorded under treatment T₇ and T₅ recorded minimum spike length of 97.55cm per plant under pooled analysis. In year wise data analysis it was clear that during 2017, maximum spike length of 103.65cm was registered under treatment T₇ closely followed by T₉ (103.55cm) which are *at par* with each other and minimum spike length was found under T₅(96.65cm).

On the other hand in 2018, maximum spike length (112.35cm) was recorded under treatment T₇ followed by T₈ (110.85cm) and minimum spike length of 97.65cm was recorded under treatment T₁. In case of umbel diameter it was clear from the same table that T₇ recorded maximum umbel diameter of 7.10 cm closely followed by T₉ (7.06cm) and minimum in T₂(5.74 cm) under pooled data. The year wise data analysis revealed that, in the first year maximum umbel diameter of 6.96cm was recorded under T₉ closely followed by T₇ and T₈ (6.85 and 6.80cm, respectively). However, in 2018 maximum umbel diameter of 7.35cm was recorded under T₇ followed by T₉, T₆ and T₈ (7.16cm, 7.15cm and 7.15cm, respectively) and minimum in T₂ (5.85cm).

Maximum seed weight per umbel (3.55g) was recorded under T₇ followed by T₉ (3.37g) and minimum (2.56g) in T₁ considering pooled data. In individual year wise data analysis, pointed out that, in 2017 maximum seed weight per umbel (3.15g) was noted in T₇ followed by T₆ (2.95g) and minimum in T₁ (2.35g). Similarly, in 2018, maximum seed weight of per umbel was recorded under treatment T₇ (3.95g) followed by T₉ (3.87g) and minimum in T₁ (2.76 g). Pooled data analysis revealed that maximum seed weight of 300.54g per plot was registered under T₇ and minimum (217.63g per plot) under treatment T₁.

Table.1 Impact of integrated nutrient management on plant height, no. of leaves, basal girth of spike and No. of inflorescence of onion cv. Sukhsagar

Treatments	Plant Height (cm)			No. of leaves			Basal girth of spike (cm)			No. of inflorescence		
	2017	2018	Pooled	2017	2018	Pooled	2017	2018	Pooled	2017	2018	Pooled
T₁	37.55	38.15	37.85	26.15	25.65	25.91	7.25	7.85	7.55	3.85	4.65	4.25
T₂	38.65	39.25	38.95	26.45	27.25	26.85	7.45	7.85	7.65	4.11	4.25	4.18
T₃	39.85	39.55	39.70	28.55	28.85	28.70	7.15	7.65	7.40	4.05	4.55	4.30
T₄	37.85	38.35	38.10	25.25	26.35	25.80	6.85	7.15	7.00	4.15	4.05	4.10
T₅	38.26	38.55	38.41	22.68	24.45	23.57	7.65	8.15	7.90	4.40	4.65	4.53
T₆	39.65	39.8	39.73	27.55	27.85	27.70	7.65	8.55	8.10	4.15	4.45	4.30
T₇	39.25	39.55	39.40	27.95	28.25	28.10	7.85	8.15	8.00	4.85	4.65	4.75
T₈	39.35	39.65	39.50	28.25	28.85	28.55	7.75	8.35	8.05	4.15	4.45	4.30
T₉	39.80	39.55	39.68	28.90	29.35	29.13	7.65	8.25	7.95	4.15	4.25	4.20
S.Em(±)	0.04	0.02	9.77	0.03	0.02	6.84	0.02	0.02	1.95	0.01	0.01	1.09
C.D.(P=0.05)	0.11	0.06	28.64	0.10	0.07	20.07	0.05	0.06	5.71	0.03	0.03	3.21

(T₁ - N₁₀₀P₈₀K₈₀ + FYM @ 5 t ha⁻¹, T₂ - N₁₂₅P₈₀K₈₀ + FYM @ 5 t ha⁻¹, T₃ - N₁₅₀P₈₀K₈₀ + FYM @ 5 t ha⁻¹, T₄ - N₁₀₀P₈₀K₁₀₀ + FYM @ 5 t ha⁻¹, T₅ - N₁₀₀P₈₀K₁₂₀ + FYM @ 5 t ha⁻¹, T₆ - N₁₂₅P₈₀K₁₀₀ + FYM @ 5 t ha⁻¹, T₇ - N₁₂₅P₈₀K₁₂₀ + FYM @ 5 t ha⁻¹, T₈ - N₁₅₀P₈₀K₁₀₀ + FYM @ 5 t ha⁻¹ and T₉ - N₁₅₀P₈₀K₁₂₀ + FYM @ 5 t ha⁻¹)

Table.2 Impact of integrated nutrient management on spike length, umbel diameter, seed weight and projected seed yield of onion cv. Sukhsagar

Treatments	Spike length (cm)			Umbel diameter (cm)			Seed weight (g plot ⁻¹)			Projected seed yield (kg ha ⁻¹)		
	2017	2018	Pooled	2017	2018	Pooled	2017	2018	Pooled	2017	2018	Pooled
T₁	99.07	97.65	98.36	6.16	6.65	6.41	213.46	221.79	217.63	432.78	449.78	441.28
T₂	99.65	102.66	101.16	5.62	5.85	5.74	222.15	229.65	225.90	449.75	473.92	461.84
T₃	103.65	105.08	104.37	6.41	6.65	6.53	228.30	239.26	233.78	453.4	485.77	469.59
T₄	97.90	99.78	98.84	6.35	6.55	6.45	242.37	248.27	245.32	465.56	483.88	474.72
T₅	96.65	98.45	97.55	6.45	6.85	6.65	254.33	265.29	259.81	492.61	525.41	509.01
T₆	102.45	111.40	106.93	6.75	7.15	6.95	255.65	305.41	280.53	518.42	603.62	561.02
T₇	103.65	112.35	108.01	6.85	7.35	7.10	285.15	315.92	300.54	545.47	628.64	587.06
T₈	103.15	110.85	107.00	6.80	7.15	6.98	253.45	282.67	268.06	509.71	582.74	546.23
T₉	103.55	110.25	106.90	6.96	7.16	7.06	285.79	298.28	292.03	519.71	595.78	557.75
S.Em(±)	0.02	0.09	25.95	0.01	0.012	1.68	0.20	0.19	66.43	0.21	0.22	131.36
C.D.(P=0.05)	0.05	0.27	76.09	0.03	0.035	4.92	0.57	0.57	194.80	0.61	0.63	385.21

(T₁ - N₁₀₀P₈₀K₈₀ + FYM @ 5 t ha⁻¹, T₂ - N₁₂₅P₈₀K₈₀ + FYM @ 5 t ha⁻¹, T₃ - N₁₅₀P₈₀K₈₀ + FYM @ 5 t ha⁻¹, T₄ - N₁₀₀P₈₀K₁₀₀ + FYM @ 5 t ha⁻¹, T₅ - N₁₀₀P₈₀K₁₂₀ + FYM @ 5 t ha⁻¹, T₆ - N₁₂₅P₈₀K₁₀₀ + FYM @ 5 t ha⁻¹, T₇ - N₁₂₅P₈₀K₁₂₀ + FYM @ 5 t ha⁻¹, T₈ - N₁₅₀P₈₀K₁₀₀ + FYM @ 5 t ha⁻¹ and T₉ - N₁₅₀P₈₀K₁₂₀ + FYM @ 5 t ha⁻¹)

Table.3 Impact of integrated nutrient management on economics of onion seed production cv. Sukhsagar

Treatments	Projected seed yield (kgha ⁻¹)	Gross return (Rs ha ⁻¹)	Cost of production (Rs ha ⁻¹)	Net profit (Rs ha ⁻¹)	Benefit cost ratio
T₁ – N₁₀₀P₈₀K₈₀ + FYM @ 5 t ha⁻¹	441.28	202988.80	61589.31	141399.49	2.29: 1
T₂ – N₁₂₅P₈₀K₈₀ + FYM @ 5 t ha⁻¹	461.84	212446.40	61776.81	150669.59	2.43: 1
T₃ – N₁₅₀P₈₀K₈₀ + FYM @ 5 t ha⁻¹	469.59	216011.40	62389.31	153622.09	2.46: 1
T₄ – N₁₀₀P₈₀K₁₀₀ + FYM @ 5 t ha⁻¹	474.72	218371.20	61776.81	156594.39	2.53: 1
T₅ - N₁₀₀P₈₀K₁₂₀ + FYM @ 5 t ha⁻¹	509.01	234144.60	62389.31	171755.29	2.75: 1
T₆ - N₁₂₅P₈₀K₁₀₀ + FYM @ 5 t ha⁻¹	561.02	258069.20	61776.81	196292.39	3.17: 1
T₇ - N₁₂₅P₈₀K₁₂₀ + FYM @ 5 t ha⁻¹	587.06	270047.60	62389.31	207658.29	3.33: 1
T₈ - N₁₅₀P₈₀K₁₀₀ + FYM @ 5 t ha⁻¹	546.23	251265.80	62389.31	188876.49	3.02: 1
T₉ - N₁₅₀P₈₀K₁₂₀ + FYM @ 5 t ha⁻¹	557.75	256 565.00	62389.31	194175.69	3.11: 1

The year wise data analysis noted that during 2017 maximum seed weight of 285.79g per plot was recorded under T₉ closely followed by T₇ (285.15g) and minimum in T₁ (213.46g). Similarly, in the second year, maximum seed yield of 315.92g per plot was recorded under T₇ followed by T₆ (305.41g) and minimum seed yield of 221.79 g per plot was recorded under treatment T₁.

The maximum projected seed yield (587.06 kg ha⁻¹) was recorded treatment T₇ followed by T₆ (561.02 kg ha⁻¹) and T₉ (557.75 kg ha⁻¹). However minimum projected seed yield of 441.28kg ha⁻¹ was observed under T₁ from the pooled data. In year wise data analysis, T₇ recorded maximum projected seed yield of 545.47 kg ha⁻¹ followed by T₉ (519.71 kg ha⁻¹) and T₆ (518.42kg kg ha⁻¹/ha) during 2017 and minimum projected seed yield of 432.78 kg ha⁻¹ was recorded under T₁. In the second year also the same trend was followed like first year. In 2018, maximum projected seed yield of 628.64 kg ha⁻¹ was recorded under T₇ followed by T₆ (603.62 kg ha⁻¹) and T₉ (595.78 kg ha⁻¹) and minimum in T₁ (449.78kg kg ha⁻¹).

Data presented in table 3 revealed that, highest gross return of Rs. 270047.60 per hectare, maximum net return of Rs.207,658.29 per hectare with highest B: C ratio of 3.33:1 was found under T₇ (N₁₂₅P₈₀K₁₂₀ + FYM @ 5 t ha⁻¹) towards onion seed production of local cultivar Sukhsagar.

From the results revealed that the higher dose of nitrogenous fertilizer might influence the vegetative growth of the plants by increasing the plant height, number of leaves, basal girth of the spike, number of inflorescences etc but it might not increase the seed yield per umbel, seed yield per ha alone. The role of potassium in association with nitrogen in seed production was also important. From the tables of yield parameters it was clear that maximum seed

yield per umbel, seed yield per plot and projected seed yield per ha were recorded under treatment T₇ where NPK was applied @ 125: 80: 120 kg ha⁻¹ +5 t FYM ha⁻¹ which indicates that N, K and FYM has a direct influence on seed yield of onion. This is in conformity of the findings of Yadav *et al.*, (2003). They obtained maximum yield (249.12 q ha⁻¹) and fresh weight of bulb (50.60 g) in onion variety Rasidpura Local with application of 150 kg N ha⁻¹ and 150 kg K₂O ha⁻¹. Pandey and Ekpo (1991), also reported that highest plant height (63.9 cm) and highest number of leaves (13) were recorded when N@160 kg ha⁻¹ was applied in two equal split doses at 10 and 25 days after transplanting. Singh and Chaure (1999) also reported that 6 weeks old onion seedlings supplied with N @ 150 kg ha⁻¹ showed highest number of leaves per plant with higher plant height. Baloch *et al.*, (1991) reported that in onion highest plant height (38.5 cm) and number of leaves per plant (17.0) were obtained with 125 kg N +100 kg K₂O ha⁻¹. In a study Nagaich *et al.*, (1999) also opined that application of P₂O₅ @ 60 kg ha⁻¹ and K₂O @80 kg ha⁻¹ increased the plant height and number of leaves per plant. Bhatia and Pandey (1991) reported that highest seed yield of 20.39 g plant and 10.27qha⁻¹ ha were recorded with 150 kg N ha⁻¹. Singh *et al.*, (1993) also reported that the highest seed yield (6.64 t ha⁻¹) was recorded when treated with 120 kg N ha⁻¹.

From the above observation it can be concluded that, the role of nitrogen in association with potassium and farm yard manure in seed production of onion plays vital role. From the tables of yield parameters presented in results clearly pointed out that maximum seed yield per umbel, seed yield per plot and projected seed yield per ha were recorded under treatment T₇ followed by T₆ which indicated that N, K and FYM has direct influence on seed yield of onion. The cost benefit ratio of seed production on onion

recorded maximum in T₇ - N₁₂₅ P₈₀K₁₂₀ + FYM @ 5 t ha⁻¹ (3.33:1) followed by T₆ - N₁₂₅P₈₀K₁₀₀ + FYM @ 5 t ha⁻¹(3.17:1) and lowest in T₁ - N₁₀₀P₈₀K₈₀ + FYM @ 5 t ha⁻¹ (2.29 :1).

References

- Anonymous, 2016. Annual Report, Directorate of Onion and Garlic Research, ICAR, Rajgurunagar, Pune.
- Baloch, M. A., Baloch, A. F. and Ansari, A. H. 1991. Growth and yield response of onion to different Nitrogen and Potassium fertilizer combinations levels. *Sarhad J. Agriculture*, 7(2):62-66.
- Bhatia, A. K. and Pandey, U. C. 1991. Effect of planting methods, fertility levels and spacing on seed production of *Kharif* onion. *Research and Development Reporter*, 8(1): 10-16.
- Debnath, S., Boo Ho, Hwang, S. J., Bae, C. S., 2008. Extraction and characterization of some natural plant pigments. *Industrial crops and products*, 40: 129-135.
- Gomez, K. A. and Gomez, A. A. (1984). *Statistical Procedures in Agricultural Research*. 2nd Ed., John Wiley and Sons, New York, USA., pp 680.
- Nagaich, K. N; Trivedi, S. K. and Rajesh, L. 1999. Effects of phosphorus fertilization in onion (*Allium cepa* L.). *Hort.J.*, 12(1):25-31
- Pandy, U. E and Ekpo, U. 1991. Response of nitrogen on growth and yield of onions (*Allium cepa* L.) in Maiduguri. *Research Development Reporter*, 8(1):5-9.
- Patil, H. M., Shete, B. T. and Kolekar, P. T. 1992. Effect of integrated nutrient management on growth and yield of onion (*Allium cepa* L.) seed production. *Int. J. Agric. Sci.*,3(2): 83-86.
- Selvaraj, S. 1976. Onion queen of the Kitchen. *Kisan world*, 3 (12): 32-34.
- Singh, J. and Chaure, N. K. 1999. Effect of age of seedlings and nitrogen levels on growth and yield of onion (*Allium cepa* L.). *Advance in Horticultural and Forestry*, 6 (8):73-77.
- Singh, J. P., Singh, M. K. and Singh, R. D. 1993. Growth and yield of onion (*Allium cepa* L.) bulb as influenced by date of transplanting, nitrogen and potash fertilization. *Vegetable science*, 20(1): 14-17.
- Yadav, K. S., Nehra, B. K. Lakshminarayana, K. Malik, Y. S. and Singh, N. 2003. Role of Azotobacter biofertilizer in seed production of onion. *Newslett. National Horticulture Research Development Foundation*, 23(3): 19-22.
- Yawalker, K. S. 1985. In :Vegetable Crops in India, *Agri-Horticultural Publishing House*, Nagpur, pp.288-563.

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