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GROWTH, YIELD AND STORABILITY OF ONION VARIETIES AS INFLUENCED BY INTEGRATED NUTRIENT MANAGEMENT

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Abstract

A Field experiment on onion (*Allium cepa* L.) was conducted at Regional Spices Research Centre, BARI, Gazipur ($23^0 59^/$ North Latitude and $90^0 24^/$ East Longitude) during *rabi* season of 2021-2022 and 2022-2023. The objectives were to find out promising onion variety, to develop a balanced nutrient management package for higher bulb yield with longer storability and to make a nutrient balance sheet for revealing the condition of soil fertility. The experiment was designed in Factorial Randomized Complete Block Design having three replications and nine treatments comprising three winter onion varieties: BARI Piaz-1 (V_1), BARI Piaz-4 (V_2) and BARI Piaz-6 (V_3) and three nutrient management packages i.e., 100% RDF (120-60-100-20-3-1.5 kg NPKSZnB ha^{-1}) + Cowdung @ 5 tha^{-1} (N_1), 100% RDF + Vermicompost @ 3 t ha^{-1} (N_2) and 100% RDF + Poultry manure @ 3 t ha^{-1} (N_3) kg ha^{-1}. The highest bulb yield (30.65 and 32.06 t ha^{-1}), marketable bulb yield (29.24 and 31.03 t ha^{-1}) was recorded from var. BARI Piaz-4 cultivated with 100% RDF + Vermicompost @ 3 t ha^{-1} in both the year. The net nutrient balance of N (-38 to -146 kg ha^{-1}), K (-10.92 to -21.06 kg ha^{-1}) and S (-0.70 to -2.68 kg ha^{-1}) showed negative balance but P (0.3 to 0.8 kg ha^{-1}) was positive. The highest total physiological loss of weight (PLW) of onion (19.5 and 21.7% in both the year) was recorded when onion var. BARI Piaz-6 was fertilized with 100% RDF + Poultry manure @ 3 t ha^{-1} during 120 days of storage. Among the onion varieties, BARI Piaz-6 was more susceptible to PLW. Hence, BARI Piaz-4 appeared as high yield potential onion variety and a combination of 120-60-100-20-3-1.5 kg NPKSZnB ha^{-1} + Vermicompost @ 3 t ha^{-1} was found to be the most suitable package in augmenting yield and sustaining soil health in the studied location of Madhupur Tract (AEZ-28).

Keywords: Onion varieties, nutrient management, bulb yield, storability and nutrient balance sheet.

Introduction

In Bangladesh, onion ranks first in production among the spice crops covering 1.94 lakh hectares of land and produced 22.69 lakh Metric tons bulb production with an average yield of 11.7 t ha^{-1} (BBS, 2022), which is lower in comparison to the world average yield of 19.7 t ha^{-1} (FAO, 2022). Plant nutrient elements are essential as a constituent of chlorophyll, amino acids, proteins and nucleic acids, those are responsible for photosynthesis leading to formation of protoplasm and new cells

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for growth, development and improve the storability (Bangali *et al*., 2012 and Walle *et al.*, 2018). Farmers usually do not use balanced dose of fertilizers and manure, which hampers growth, yield and storability of onion (Yayeh *et al.*, 2017). Selection of suitable variety, soil moisture and nutrient management are most essential factors which, with optimum application, increase bulb yield and storability caused huge yield reduction (Gnanasundari *et al*., 2022; Kumara *et al*., 2018). Moreover, Kumar *et al.* (2007) reported that the growth and yield parameters such as plant height, number of leaves per plant, biomass, individual bulb weight and bulb yield increased significantly with appropriate nutrient management. Bangladesh Agricultural Research Institute (BARI) has developed three high yielding winter onion varieties like, BARI Piaz-1, BARI Piaz-4 and BARI Piaz-6 (Khan *et al.*, 2023) having higher yield potentiality but its lower yield in farmer's field are due to improper use of fertilizers and manures (Hasan and Mozumder, 2023 Hence, the present study was undertaken to find out the promising onion variety and to develop a balanced nutrient management package for higher bulb yield with longer storability and to develop a nutrient balance sheet for revealing the condition of soil fertility

Materials and Methods

The present study was conducted at the research field of Regional Spices Research Center, BARI, Gazipur, during two consecutive growing seasons of 2020-2021 and 2021-2022. The experimental site was situated at $23^0 59^/$ North Latitude and $90^0 24^/$ East Longitude, at an altitude of 8.4 m above the mean sea level. The soil of the experimental site belongs to Chhiata Soil series classified as Grey Terrace Soil of Inceptisol under the AEZ-28 (Madhupur Tract) reported by Brammer (1971). The initial soil samples of the experimental field were collected (0-15 cm depth) and analyzed in the Soil Science Laboratory, BARI, Gazipur following standard and recommended methods (Table 1). The experiment was laid out in Factorial Randomized Complete Block Design with nine treatment combinations were: Factor A:- three onion varieties [BARI Piaz-1 (V_1), BARI Piaz-4 (V_2) and BARI Piaz-6 (V_3)] and Factor B:- three nutrient management packages i.e., 100% RDF (120-60-100-20-3-1.5 kg NPKSZnB ha^{-1}) + Cowdung @ 5 t ha^{-1} (N_1), 100% RDF + Vermicompost @ 3 t ha^{-1} (N_2) and 100% RDF + Poultry manure @ 3 t ha^{-1} (N_3) having three replications. The recommended dose of chemical fertilizer (RDF) was measured by soil test basis (STB) using FRG, 2018. Seeds were soaked in water for 12 hours and treated with Autostin (*Carbendazim*) @ 2 g kg^{-1} before sowing to control primary seed-borne diseases. The seeds were sown @ 30 g per seed bed (3 m x 1 m) on 15 October 2022. Healthy seedlings of 40 days were transplanted into the main field maintaining10 cm x10 cm spacing on 25 November 2022. The unit plot size was 3.0 m x 1.2 m with 30 cm deck around the plot. Cowdung, vermicompost, poultry manure and chemical fertilizers such as triple super phosphate, gypsum, zinc sulphate and boric acid as a source of P, K, S, Zn and B, respectively as per treatment were applied as basal before final land

preparation. Nitrogen and potassium in the form of urea and muriate of potash, respectively were applied at two equal splits where, the 1st split was top dressed at 25 days after transplanting (DAT) and the second at 50 DAT. The intercultural operations like hand weeding were done thrice to control weed, spraying of Ridomil Gold (*Mancozeb + Metalaxyl*) @ 2.5 g l^{-1} and Ruvral (*Iprodione*) @ 2.5 g l^{-1} in alternation with Admire (*Imidacloprid*) @ 2.0 m l^{-1} were done at 12 days interval for controlling disease and insect pest. The bulbs were harvested 10 days after 80% neck fall on 22 March 2023. Data on plant height, number of leaves per plant, neck thickness, days to maturity, bulb size, individual bulb weight and bulb yield were recorded for each treatment from randomly selected 10 plants before harvest. The harvested bulbs were cured for three days in a well aerated shady place to make the bulb firm, dried and colored. Marketable bulb yield was determined by discarding bulb size smaller than 1.5 cm in diameter, injured, thick necked, bolted and rotten to total number of normal bulbs per plot. To enhance the shelf-life after curing, bulbs were cut at 5-7 cm above neck region for storing. The physico-chemical properties of soil in the experimental site are presented in Table 1. Nutrient contents of organic manures used in the experiment are shown in Table 2. About 10 kg of cured bulbs were stored in a plastic rack at room temperature to observe shelf-life of onion on 27 March 2022. The data on physiological loss in weight were recorded at 30 days interval up to 120 days of storage. After harvesting 10 (ten) selected onion plants from each plot were uprooted, air-dried in the laboratory and finally oven-dried for 72 hours at 65^0C to estimate dry matter production. The dry matter was calculated by the following formula (Yousuf, 2005):

$$DM = [\{(DY /10) X NP\} X 10000)]/1000$$

Where, DM = Dry matter (kg ha^{-1})

DY = Total dry matter yield of 10 plants per plot (g)

NP = Total number of plants per m^2

Nutrient uptake from the soil was calculated by using the formula:

Nutrient uptake = % A x Y / 100 kg ha^{-1}

Where, % A = Nutrient content of plant in percent; Y = Total dry matter production of plant (kg ha^{-1})

Nutrient balance sheets were estimated by using the formula (Singh *et al.*, 2017):

Nutrient balance (N, P, K, S) = Σ Input (N, P, K, S) – Σ Output (N, P, K, S)

Where,

Input: Chemical fertilizer, manure, BNF, deposition (rain), airborne, sedimentation.

Output: Harvested crop parts, crop residues, leaching, gaseous losses, soil erosion.

However, the nutrient balance did not account for the addition of nutrients from rainfall, dry deposition, BNF and removal of nutrient by leaching, gaseous losses of N, or weed uptake of nutrients from the soil.

For measuring the TSS, bulb tissue (20.0g) was homogenized in a blender and centrifuged for 20 min at 12000 rpm under 4^0C, the supernatant was analyzed at room temperature with a hand refractometer, expressed as ^{0}Brix. The recorded data on different parameters were statistically analyzed by using the software, *R* 3.5.5 to find out the significance of variation resulting from different treatments. The difference between treatment means were judged by Least Significant Difference (LSD) test at 5% level of significance.

Table 1. Initial soil physical and chemical properties of soil of the experimental site

Soil Chemical Properties	Analytical value	Analytical method
Textural class	Clay loam	Hydrometer method
Bulk density (g cm^{-3})	1.38	Core sampling method
Particle density (g cm^{-3})	2.65	Pycnometer method
Soil pH	6.2	Soil: water=1:2.5
Organic carbon (%)	0.89	Wet oxidation method
Total N (%)	0.09	Micro Kjeldhal Method
Available P (ppm)	7.78	Bray and Kurtz method
Exchangeable K (meq 100 g^{-1} soil)	0.08	N NH_4OAc Extraction method
Available S (ppm)	6.57	Calcium dihydrogen phosphate extraction method
Available B (ppm)	0.18	Calcium chloride extraction method
Available Zn (ppm)	0.57	DTPA Extraction method
Available Cu (ppm)	0.17	DTPA Extraction method
Available Mn (ppm)	0.75	DTPA Extraction method
CEC (meq 100 g^{-1} soil)	9.3	N NH_4OAc Extraction method

Table 2. Nutrient contents in different organic manure used in the experiment

Organic manure	pH	OC	N	P	K	S
		(%)				
Cowdung	7.3	13.9	1.1	0.5	0.6	0.06
Vermicompost	7.6	11.7	1.8	1.1	0.9	0.03
Poultry manure	7.7	14.9	1.9	0.9	0.8	0.04

Results and Discussion

The interaction effects of onion variety and nutrient management packages were significant for plant height, number of leaves per plant and bulb size of onion

(Table 3). The maximum plant height (58.7 and 66.0 cm), number of leaves per plant (14.3 and 18.3) and biggest bulb (5.93 x 6.07 and 6.07 x 6.43 cm^2) were recorded with BARI Piaz-4 and application of 100% RDF + Vermicompost @ 3 t ha^{-1} (V_2N_2) during 2021-2022 and 2022-2023, respectively. The minimum plant height (35.0 and 42.3 cm), number of leaves per plant (7.3 and 9.3) and bulb size (3.73 x 4.13 and 4.77 x 5.23 cm^2) were observed in BARI Piaz-1 fertilized with 100% RDF (120-60-100-20-3-1.5 kg NPKSZnB ha^{-1}) + Cowdung @ 5 t ha^{-1} (V_1N_1) in both the years. Plant nutrients favored vegetative growth of onion plans by enhancing physiological and metabolic activities (Asgele *et al.*, 2018).

Table 3. Effects of onion variety and nutrient management on plant height, no. of leaves per plant and bulb size of onion

Treatment	Plant height (cm)		No. of leaves per plant		Bulb length (cm)		Bulb diameter (cm)	
	2021-22	2022-23	2021-22	2022-23	2021-22	2022-23	2021-22	2022-23
V_1 N_1	35.0f	42.3e	7.3d	9.3f	3.73d	4.13d	4.77c	5.23b
V_1 N_2	39.3e	49.0c	7.7d	12.0de	3.87d	4.43cd	5.0c	5.27b
V_1 N_3	38.3e	45.0de	8.0d	10.3ef	3.83d	4.33cd	5.07bc	5.20b
V_2 N_1	55.7b	64.0a	13.0b	16.3b	5.43ab	5.97a	5.53abc	6.07a
V_2 N_2	58.7a	66.0a	14.3a	18.3a	5.93a	6.07a	5.77a	6.43a
V_2 N_3	57.0ab	60.7b	13.7ab	15.7b	5.87a	5.97a	5.6ab	6.23a
V_3 N_1	41.7d	46.0d	9.7c	13.0cd	4.0d	4.60c	5.03bc	5.27b
V_3 N_2	45.0c	49.0c	10.3c	14.7bc	4.93bc	5.13b	4.87c	5.43b
V_3 N_3	42.0d	46.0d	9.3c	12.3de	4.67c	4.7c	4.87c	5.23b
CV (%)	2.57	3.18	7.07	2.12	7.19	4.15	6.71	5.58

Treatment means followed by the same letter(s) do not differ significantly at 5% level of probability by LSD test.

The combined effects of onion variety and nutrient management packages were significant for single bulb weight, neck thickness, TSS and days to maturity of onion (Table 4). The maximum bulb weight (82.67 and 86.1 g), neck thickness (1.63 and 1.57 cm), TSS (14.7 and 15.93^{0}Brix) and maximum day required to mature bulb (111 and 115 days) and were recorded from plot subjected to BARI Piaz-4 with application of 100% RDF + Vermicompost @ 3 t ha^{-1} (V_2N_2) in both the years. The minimum bulb weight (42.43 and 55.7 g), neck thickness (0.79 and 0.87 cm) and TSS (12.4 and 13.07^{0}Brix) were recorded under BARI Piaz-1 with application of 100% RDF (120-60-100-20-3-1.5 kg NPKSZnB ha^{-1}) + Cowdung @ 5 t ha^{-1} (V_1N_1). But the minimum day required to mature bulb (71 and 73 days) was noted in tretment V_3N_3 in both the years. It is assumed that the IPNS based nutrient management supplied sufficient macro & micro nutrients, which favored growth promoting and enzymatic activities of plants.

Table 4. Effects of onion variety and nutrient management on yield contributing components of onion

Treatment	Single bulb weight (g)		Neck thickness (cm)		TSS (^{0}Brix)		Days to maturity	
	2021-22	2022-23	2021-22	2022-23	2021-22	2022-23	2021-22	2022-23
$V_1 N_1$	45.43c	55.7b	0.79c	0.87b	12.4b	13.07b	88	90b
$V_1 N_2$	52.50bc	56.2b	1.16b	1.08b	12.5b	13.63b	86b	89b
$V_1 N_3$	50.77bc	54.1b	1.14b	0.88b	12.6b	13.60b	87b	88b
$V_2 N_1$	76.47a	80.3a	1.60a	1.53a	14.6a	15.90a	111a	114a
$V_2 N_2$	82.67a	86.1a	1.63a	1.57a	14.7a	15.93a	111a	115a
$V_2 N_3$	81.90a	85.3a	1.60a	1.56a	14.6a	15.83a	110a	113a
$V_3 N_1$	54.0b	60.3b	0.97bc	1.0b	12.8b	13.17b	72c	73c
$V_3 N_2$	52.67bc	59.8b	1.01bc	1.05b	12.7a	13.17b	73c	74c
$V_3 N_3$	53.87b	57.1b	0.94bc	1.10b	12.7b	13.17b	71c	73c
CV (%)	7.04	6.54	16.97	15.69	3.73	6.59	3.00	2.26

Treatment means followed by the same letter(s) do not differ significantly at 5% level of probability by LSD test

Total bulb yield, marketable bulb yield and biomass yield of onion were significantly influenced by variety and nutrient management (Table 5). The maximum bulb yield (30.65 and 32.06 t ha^{-1}), marketable bulb yield (29.24 and 31.03 t ha^{-1}) and biomass yield (4.07 and 4.13 t ha^{-1}) of onion were obtained from V_2N_2 treatment in both the years The lowest bulb yield (17.29 and 18.92 t ha^{-1}), marketable bulb yield (15.65 and 17.63 t ha^{-1}) and biomass yield (2.4 and 2.43 t ha^{-1}) were recorded from treatment V_1N_1 in both the years. Biomass production depends on the synthesis, accumulation and translocation of photosynthates which depend upon efficient photosynthetic structure as well as source sink relationship. The biomass yield is mostly controlled by nutrient mobility and translocation of photosynthates by plant. This may be due to nutrient availability in the root zone, leads to enhance plant growth and development (Yayeh *et al.*, 2017 and Kumar *et al.*, 2007).

Table 5. Effects of onion variety and nutrient management on bulb yield, marketable yield and biomass yield of onion

Treatment	Total bulb yield (tha^{-1})		Marketable yield (tha^{-1})		Biomass yield (tha^{-1})	
	2021-22	2022-23	2021-22	2022-23	2021-22	2022-23
$V_1 N_1$	17.29e	18.92d	15.65e	17.63d	2.40b	2.43c
$V_1 N_2$	17.84de	19.19d	16.48de	18.53d	2.77b	2.91bc
$V_1 N_3$	17.41e	19.13d	15.67e	17.83d	2.77b	2.87bc
$V_2 N_1$	27.06b	29.38b	24.74b	28.47b	3.97a	4.03a
$V_2 N_2$	30.65a	32.06a	29.24a	31.03a	4.07a	4.13a
$V_2 N_3$	29.66a	30.87ab	28.44a	30.2ab	4.03a	4.10a
$V_3 N_1$	20.85c	22.28c	19.42c	21.0c	3.03b	3.10bc
$V_3 N_2$	21.15c	22.58c	19.71c	21.43c	3.13b	3.27bc
$V_3 N_3$	19.9cd	21.55c	18.24cd	20.57c	2.90b	3.0bc
CV (%)	5.48	4.49	5.40	4.99	13.60	13.35

Treatment means followed by the same letter(s) do not differ significantly at 5% level of probability by LSD test

Storability

Onion is non climacteric perishable crop producing low endogenous ethylene during storage and encounters 35-40% post-harvest losses during storage owing to decay, sprouting and physiological weight loss (Anbukkarasi *et al.*, 2013). The storability of onion depends on variety, bulb size, shape with content of TSS, maturity at harvest, production technologies, storage condition and climatic condition. The effects of both variety and nutrient management on physiological loss of weight (PLW) of onion was observed in up to 120 days of storage (Figure 1 and 2). However, PLW increased at faster rate recorded higher loss during storage in initial stage, which was the highest in BARI Piaz-6. The maximum PLW was (19.5 and 21.7%) recorded in N_3V_3, the minimum PLW (10.4 and 12.7%) was noted in the treatment of BARI Piaz-1 with application of 120-60-100-20-3-1.5 kg NPKSZnB ha^{-1} + Cowdung @ 5 t ha^{-1} in both the years. Onion variety under higher yield potentiality had accumulated higher moisture and nutrients, where nitrogen might have played major role in producing higher bulb size with higher moisture content and tends to lose more weight and enhanced susceptibility to diseases and early sprouting during storage. On the other hands, onion variety having smaller bulb size utilized lower soil moisture and nutrient showed less physiological weight loss to keep well during the 120 days storage. Similar result was reported by Kumar *et al*. (2007).

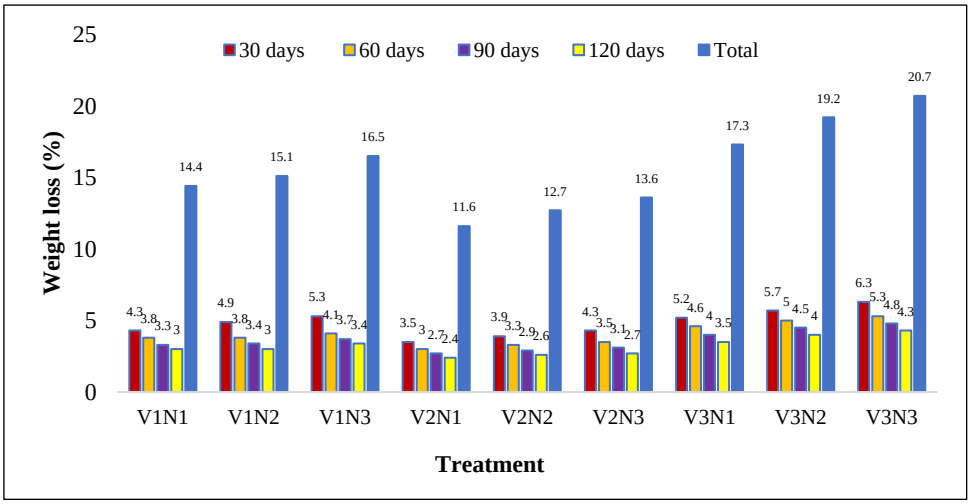

Fig. 1. Effect of variety and nutrient management packages on storability of onion.

Uptake of N, P, K and S

N, P, K and S uptake by onion plants under different nutrient management packages were studied (Figure 2). It was observed that the maximum uptake of N, P, K and S were 126.58, 17.09, 115, 18 and 19.30 kg ha^{-1}, respectively in treatment V_2N_2 in both the years while minimum uptake of N (63.71 kg ha^{-1}) was obtained

in treatment V_3N_3. It was also observed that the minimum uptake of P, K and S were 7.44, 60.0 and 12.96 kg ha-1, respectively in treatment V_1N_3 in both the years. Addition of chemical fertilizers and manure in soil increase availability of N, P, K and S contents in soil, resulting improved soil physical and chemical properties of soil. Maintenance of optimum levels of N, P, K and S in soil had led to favored in better plant growth and also higher transpiration rate, thus led to higher absorption of nutrients also. These results are in agreement with the research findings of Nasreen *et al*. (2007) and Kumara *et al.* (2018).

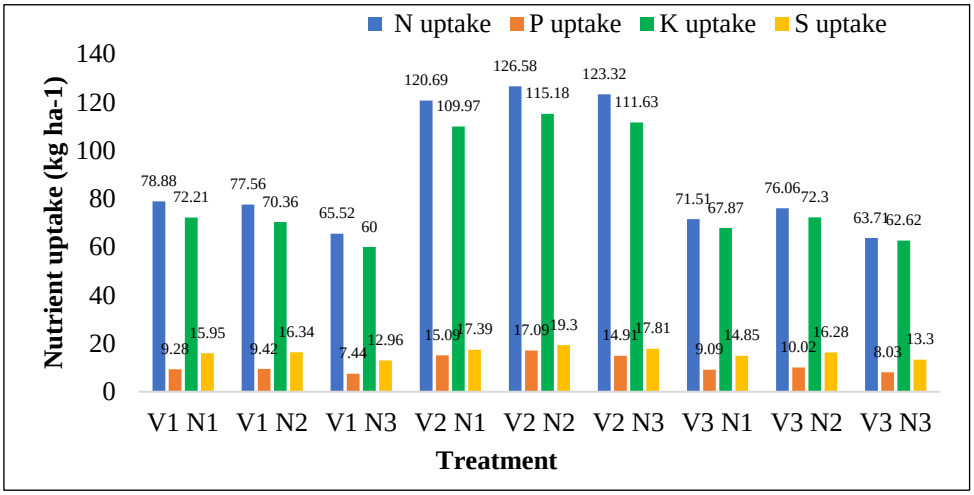

Fig. 2. Effect of variety and nutrient management packages on nutrient uptake of onion.

Post-harvest soil N, P, K and S status

The data presented in Figure 3a and 3b revealed that adoption of different nutrient management packages for two consecutive years in onion cultivation have remarkably influenced post-harvest soil N, P, K and S fertility status. The maximum value of residual N (1698 kg ha^{-1}) was recorded in V_3N_2 treatment, residual P (16.36 $kgha^{-1}$) in treatment V_3N_1, residual K (51.48 kg ha^{-1}) in V_1N_2 treatment and S (12.42 kg ha^{-1}) in V_1N_3 treatment. The minimum value of residual N and P were 1654 and 16.02 kg ha^{-1}, respectively recorded in treatment V_2N_3 followed by V_2N_1 and also residual S (10.46 kg ha^{-1}) was observed in treatment V_2N_2. It can be inferred from results that higher nutrient availability due to application of fertilizers and manures contributed to uptake by the crop and sustained the soil fertility to some extent as well as higher N, P, K and S reserves post-harvest soil. These findings were confirmed by Al-mansour *et al.* (2020); Kumar *et al*. (2018).

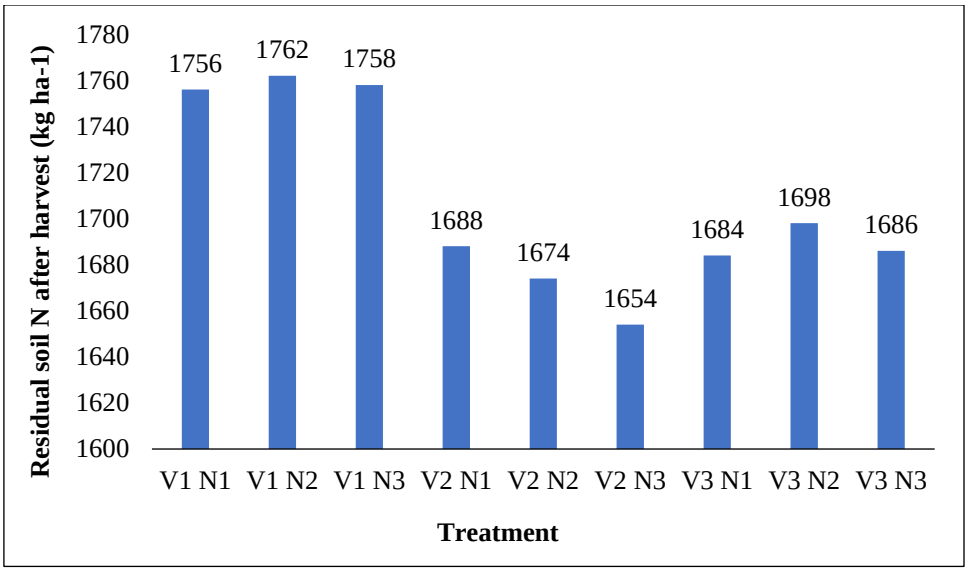

Fig. 3a. Effect of variety and nutrient management packages on residual soil N after harvest of onion.

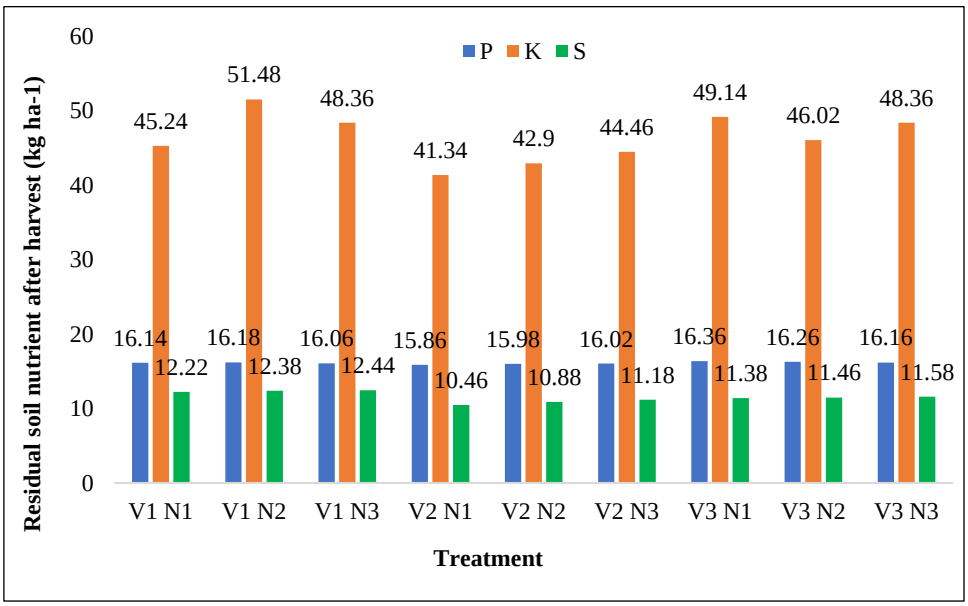

Fig. 3b. Effect of variety and nutrient management packages on residual soil P, K and S after harvest of onion.

Apparent N, P, K and S balance

Apparent N, P, K and S balance of onion were influenced by the application different nutrient management packages (Figure 4). The range of apparent N

balance (-227.29 to -134.44 kg ha^{-1}), P balance (-99.17 to -69.61 kg ha^{-1}), K balance (-78.04 to -30.31 kg ha^{-1}) and S balance (-17.7 to -3.86 kg ha^{-1}) were noted with the application of NPKS fertilizers in 2021-2022 and 2022-2023, respectively. The maximum apparent N balance (-134.44 kg ha^{-1}) was recorded in treatment V_1N_2 followed by V_2N_1, V_2N_3 and V_2N_2 The minimum apparent N balance (-227.29 kg ha^{-1}) was recorded in treatment V_3N_3 followed by V_1N_2 (-78.04 kg ha^{-1}) in treatment V_1N_3. The apparent negative N, P, K and S balance of soil indicate that soil has unable to supply sufficient N, P, K and S for proper growth and development of crops. These results are in close conformity with the research findings of Shehata and Moubarak (2020) and Kucha *et al.* (2018).

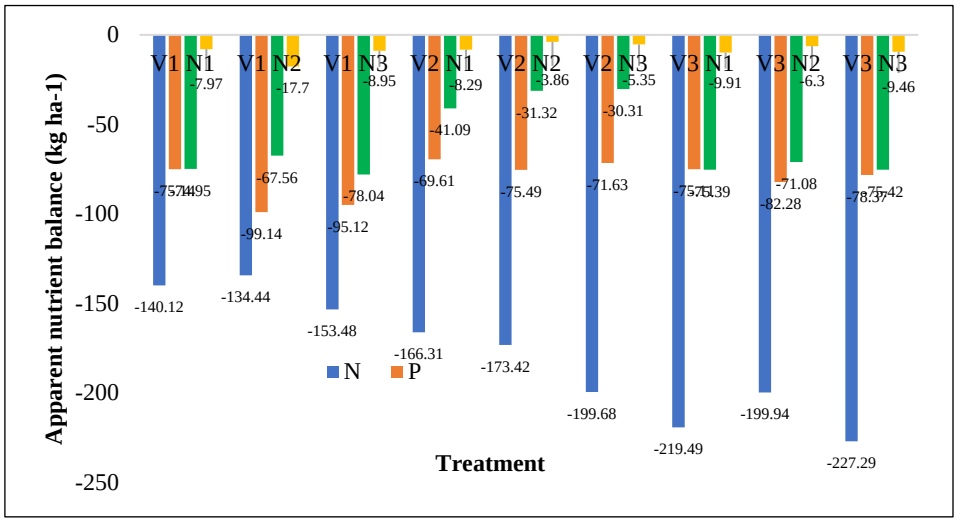

Fig. 4. Effect of variety and nutrient management packages on apparent nutrient balance of onion.

Net N, P, K and S balance

. Positive balance indicated the nutrient accumulation and negative balance eventually cause soil degradation and adversely affect crop production. On the other hand, excess nutrient accumulation may lead to soil, water and air pollution. The N, P, K and S balance of onion due to application of different nutrient management packages were observed (Figure 5a and 5b). The range of net N balance (-146 to -38 kg ha^{-1}), P balance (0.3 to 0.8 kg ha^{-1}), K balance (-21.06 to –30.31 kg ha^{-1}) and S balance (-2.68 to -0.70 kg ha^{-1}) were observed with the application of different nutrient management packages in both the years. The results showed that net N, K and S balance in soil remained negative. The maximum net balance of N and K were -38.0 and 10.92 kg ha^{-1}, respectively were recorded in treatment V_1N_2 and net S balance (-0.70 kg ha^{-1}) was noted in treatment V_1N_3. The minimum net N balance (-146.0 kg ha^{-1}) was recorded in treatment V_2N_3 while the minimum net K and S balance -21.06 and -2.68 kg ha^{-1} were obtained in

treatment V_2N_1 . The net P balance was positive both the years (Fig. 5b). The maximum net P balance (0.8 kg ha^{-1}) was recorded in treatment V_3N_1 followed by V_1N_2. It may be due to higher availability of nutrients in root zone and enhanced bio-chemical activities of onion plants. These results of these investigation are in agreement of Al-mansour et al. (2020); Kucha *et al*. (2018).

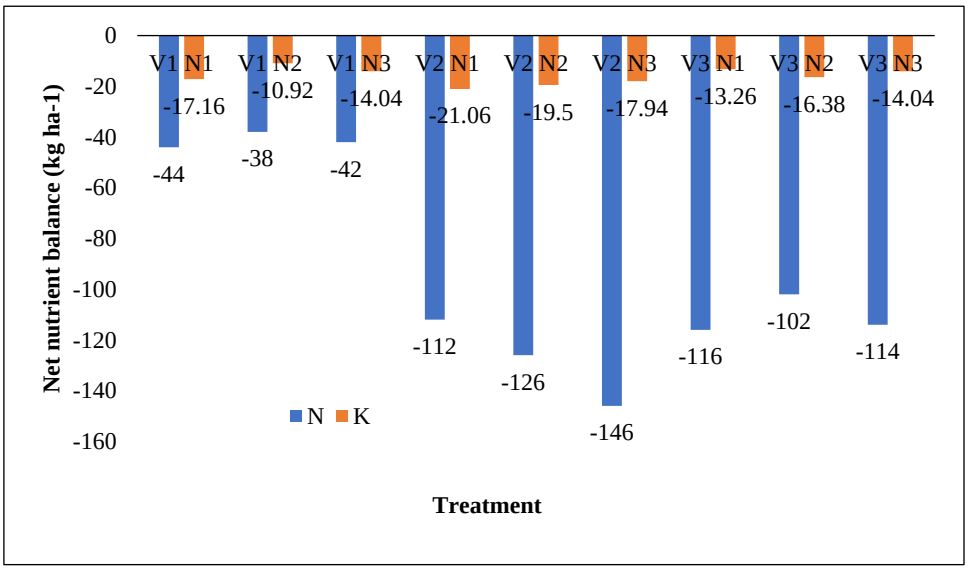

Fig. 5a. Effect of variety and nutrient management packages on net N and K balance of onion.

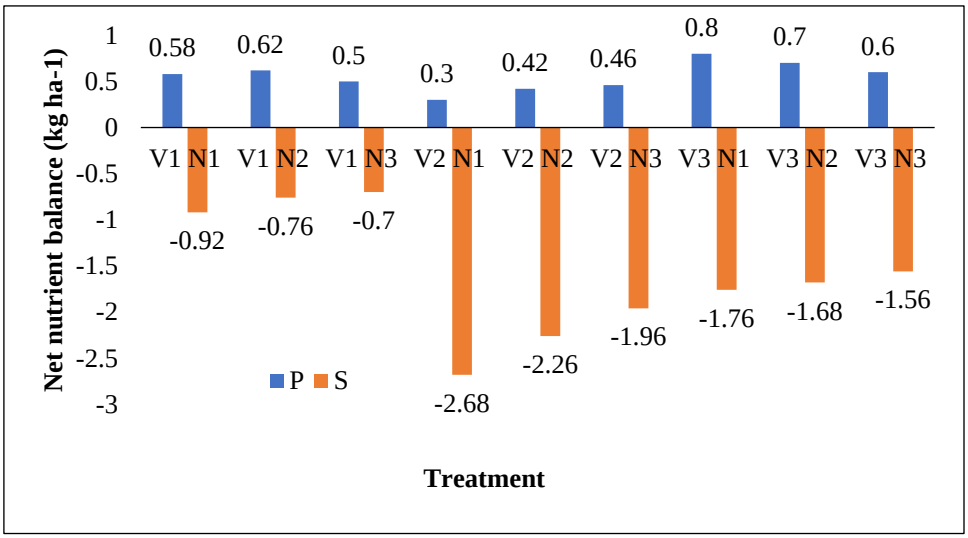

Fig. 5b. Effect of variety and nutrient management packages on net P and S balance of onion.

Conclusion

It may thus be concluded from the results of the present study that bulb yield and storability of onion varieties was significantly influenced by application of organic manure in combinations chemical fertilizer. The highest total bulb yield (30.65 and 32.06 t ha^{-1}) and marketable bulb yield (29.24 and 31.03 t ha^{-1}) in 2021-2022 and 2022-2023, respectively was obtained from onion var. BARI Piaz-4 with application of 100% RDF (120-60-100-20-3-1.5 kg NPKSZnB ha^{-1}) + Vermicompost @ 3 t ha^{-1}. The uptake of N, P, K and S by the crop was also highly favoured by the same treatment. Thus, BARI Piaz-4 appeared as high yield potential onion variety and a combination of 120-60-100-20-3-1.5 kg NPKSZnB ha^{-1} + vermicompost @3 t ha^{-1} to be the most suitable package in augmenting yield and sustaining soil health in the study location (AEZ-28) and similar other soils of the country.

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