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Shyam Sunder Sharma
Department of Soil Science and Agricultural Chemistry, Rajasthan College of Agriculture, MPUAT, Udaipur, Rajasthan, India

KK Yadav
Department of Soil Science and Agricultural Chemistry, Rajasthan College of Agriculture, MPUAT, Udaipur, Rajasthan, India

DP Singh
Department of Soil Science and Agricultural Chemistry, Rajasthan College of Agriculture, MPUAT, Udaipur, Rajasthan, India

RH Meena
Department of Soil Science and Agricultural Chemistry, Rajasthan College of Agriculture, MPUAT, Udaipur, Rajasthan, India

SS Lakhawat
Department of Soil Science and Agricultural Chemistry, Rajasthan College of Agriculture, MPUAT, Udaipur, Rajasthan, India

HK Jain
Department of Soil Science and Agricultural Chemistry, Rajasthan College of Agriculture, MPUAT, Udaipur, Rajasthan, India

RS Choudhary
Department of Agronomy, Rajasthan College of Agriculture, MPUAT, Udaipur, Rajasthan, India

Correspondence
Shyam Sunder Sharma
Department of Soil Science and Agricultural Chemistry, Rajasthan College of Agriculture, MPUAT, Udaipur, Rajasthan, India

Effect of integrated nutrient management on the growth and productivity of onion (*Allium cepa* L.)

Shyam Sunder Sharma, KK Yadav, DP Singh, RH Meena, SS Lakhawat, HK Jain and RS Choudhary

Abstract
A field experiment was conducted at Rajasthan College of Agriculture, MPUAT, Udaipur during late *kharif* 2018-19. In present investigation, 12 treatments combinations comprising four fertility levels of (control, 100% RDF, 75% RDF and 50% RDF), three bio-fertilizer level (*Azotobacter*, PSB and *Azotobacter* + PSB) and two FYM level (25% and 50% FYM). The experiment was laid out according to randomized block design with three replications. On the basis of the results emanated from present investigation, it could be concluded that application of 100% recommended dose of fertilizer and *Azotobacter* + PSB may be applied in onion to significantly increases growth and yield parameter *i.e.* plant height, fresh weight of plant, bulb weight, yield per plot and yield per ha in clay soil of agro-climatic zone lVa of Rajasthan.

Keywords: Fertilizer levels, FYM, bio-fertilizer, growth, fresh weight, yield, onion

Introduction
Onion (*Allium cepa* L.) is a bulbous, biennial herb belonging to family Amaryllidaceae (Alliaceae), having chromosome 2n=16, that is originated in Central Asia and grown during winter season. Onion is an important bulb vegetable crop having importance at National and International levels.

The smell and pungency is due to the oil known as "Allyl propyl disulphide". Onion contains carbohydrates (13.70%), proteins (1.40%), fat (0.72%), moisture (80.07%) total sugar (2.32%), vitamin C (5.7 mg) and some minerals like phosphorus (30.3 mg), potassium (129 mg), calcium (25.7 mg), iron (0.24 mg) copper (0.1mg) manganese (0.14mg) and zinc (0.4mg) per 100g (Bhattacharjee *et al.*, 2013) [2]. Extracts of onion are being used in the prevention of 'atherosclerosis' and 'coronary heart disease' as they can inhibit the aggregation of human blood platelets to form the clots, which have the potential for arterial blocking.

India is the second largest producer and third largest exporter of onion in the world. Maharashtra is the leading producer state of onion in India. The major onion producing states in India are Maharashtra, Madhya Pradesh, Karnataka, Gujarat, Rajasthan and Bihar. In India, it is grown in 1.27 million hectare area and its production is 21.596 MT bulb and productivity is 17 t/ha. In Rajasthan, it is grown in 8.5 thousand hectares area and production is 13.50 million tonnes bulb and productivity is 15.88 t/ha (Anonymous, 2018) [1].

Onion, being a nutrient loving crop, responds well to added fertilizers. The uses of inorganic fertilizer help in achieving maximum yield of onion. Among the major nutrients, nitrogen, phosphorus and potash play an important role in nutrition of onion plants in relation to growth, yield and quality of bulb. To maintain sustainability in quality production through integrated nutrient management can help to maintain the fertility of the soil (Palaniappan and Annadurai, 2000) [5].

Bio-fertilizer activate beneficial microorganisms present in the soil, utilize atmospheric nitrogen for fixation in the soil and improve the availability and uptake of existing nutrients besides exerting other beneficial effects (Singh and Kalloo, 2000) [6].

An integrated nutrient management strategy for judicious combination of both organic and inorganic sources is the demand of the present era. It may be more economically viable and also may help in attaining sustainability in production and maintaining soil health and eco-friendly environment. The integrated use of 75 percent recommended fertilizers along with biofertilizers and organic manures produced bulb yield of onion at par with the previous

recommendation (150:50:80:50 kg NPKS + 20 t FYM/ha) and improved soil organic carbon (Thangasamy and Lawande, 2015) [7].

Materials and Methods

The present experiment was conducted at Research Farm of Department of Horticulture, Rajasthan College of Agriculture, Udaipur, which is situated at 24°34 N latitude and 73°42 E longitudes at an elevation of 585.5 meters above mean sea level. The field topography of the experimental site was fairly leveled with an adequate surface drainage and clay loam texture. The Research Farm of Department of Horticulture, Rajasthan College of Agriculture, Udaipur, falls under agro climatic Zone IV A (Sub-humid Southern Plain and Aravali Hills), of Rajasthan.

The soil of experimental site was typical medium black clay soil, slightly alkaline in reaction, medium in organic carbon (0.58), low in available nitrogen (185.58 kg ha^{-1}), medium in available phosphorous (23.18 kg ha^{-1}) and medium in available potassium (254.48 kg ha^{-1}). The experiment comprised of 12 treatments with three replication. As per the various treatments full dose of manures, P & K along with half dose of N were applied as basal dose. Fertilizers are applied according to recommendation ($N:P_2O_5:K_2O$=100:50:100) through Urea, SSP and MOP. *Azotobacter* and *PSB* (bio fertilizers) were used as soil application @ 2 kg per hectare and FYM were used 20 t per ha.

Results and Discussion

Plant height

The data pertaining to plant height of onion is presented in (Table 1). It is evident that the plant height significantly varied with the conjoint application of organic inputs and mineral fertilization at all the growth stages in onion under field conditions.

The significantly higher plant height was observed in plot with treatment T_4 (100% RDF + *Azotobacter* + *PSB*) followed by treatment T_8 (75% RDF + 25% through FYM + *Azotobacter* + *PSB*) 19.28, 29.36 and 40.82 at 30, 60 and 90 DAP, respectively and T_{12} (50% RDF + 50% through FYM + *Azotobacter*+ *PSB*) 18.26, 28.40 and 40.20 cm at 30, 60 and 90 DAP, respectively. The result of integrated use of organic and inorganic sources are in close association with the findings of Jawadagi *et al.* (2012) [3].

Fresh weight of bulb

The data presented in Table 2 revealed that application of various plant nutrients through bio-fertilizers, FYM and inorganic fertilizers were significantly increased bulb weight. The maximum bulb weight was recorded with T_4 (100% RDF + *Azotobacter* + *PSB*) 75.05, 127.10 and 149.39 at 30, 60 and 90 DAP, respectively, followed by T8 (75% RDF + 25% through FYM + *Azotobacter* + *PSB*) 74.63, 125.17 and 147.97 at 30, 60 and 90 DAP, respectively. While minimum bulb weight was recorded with the control. Reddy *et al.* (2011) reported that application of 10 tonnes vermicompost ha^{-1} + 120 kg N ha^{-1} recorded significantly higher fresh bulb yield (24.45 tonnes ha^{-1}) at harvest.

Bulb weight

The data concerning the effect of different integrated nutrient management treatments on average bulb weight are presented in Table 3. Various integrated plant nutrient management treatments had significant effect on bulb weight of onion during the analysis. The mean maximum weight of bulb (52.04 g) was recorded under T_4 treatment (100% RDF + *Azotobacter* + *PSB*) followed by T_8 (51.01 g) and T_{12} (49.82) treatment while minimum bulb weight was recorded in T_1 (37.57 g) treatment and 32.61 percent more bulb weight over control (T_1) respectively (Table 3). Increased photosynthate translocation, production of dry matter and vegetative growth might have enhanced bulb weight. These findings are in accordance with the Vedpathak and Chavan (2016) [8].

Bulb yield per plot

It is observed from data presented in Table 4 that application of plant nutrients in combination through inorganic fertilizers, bio-fertilizers and organic manures significantly increase yield per plot and yield per hectare in onion.

The highest bulb yield (3.75 kg per plot) was obtained with T_4 treatment (100% RDF + *Azotobacter* + *PSB*), followed by T_8 (3.67 kg) treatment (75% RDF + 25% through FYM + *Azotobacter* + *PSB*), while, minimum bulb yield (2.71 kg) was recorded with T_1 treatment. However, T_8 treatment was at par with treatment T_{12}.

The highest bulb yield (11.56 t per ha) was obtained with T_4 treatment (100% RDF + *Azotobacter* + *PSB*), followed by T_8 (11.34 t per ha) treatment (75% RDF + 25% through FYM + *Azotobacter* + *PSB*), while, minimum bulb yield (8.35 t per ha) was recorded with T_1 treatment. However, T_8 treatment was at par with treatment T_{12}. Hence, in order to fight future degradation of soil fertility, productivity, adoption of integrated nutrient management which consists of inorganic sources, biofertilizers and FYM as per crop need, have been postulated (Jha *et al*., 2006) [4].

Table 1: Effect of integrated nutrient management on plant height (cm) at different growth stages of Onion

Treatments	30 Dap	60 Dap	90 Dap
T_1	11.40	19.64	35.83
T_2	16.44	28.13	39.25
T_3	15.91	26.97	38.96
T_4	19.53	29.81	42.03
T_5	17.02	25.43	38.42
T_6	17.71	27.29	39.22
T_7	17.10	27.00	38.76
T_8	19.28	29.36	40.82
T_9	16.73	26.13	38.30
T_{10}	17.14	27.90	39.35
T_{11}	16.83	26.71	38.53
T_{12}	18.26	28.40	40.20
SEm±	0.94	1.01	1.00
CD (P=0.05)	2.75	2.97	2.94

Table 2: Effect of integrated nutrient management on fresh weight (g) per plant at different growth stages of onion

Treatments	30 Dap	60 Dap	90 Dap
T_1	53.40	73.63	79.65
T_2	70.23	114.95	131.11
T_3	69.01	100.49	123.53
T_4	75.05	127.10	149.39
T_5	66.50	82.63	103.78
T_6	73.97	113.61	116.72
T_7	70.79	89.33	109.01
T_8	74.63	125.17	147.97
T_9	71.60	106.39	108.88
T_{10}	72.57	114.68	117.63
T_{11}	71.75	109.42	111.65
T_{12}	73.63	125.30	133.55
SEm±	2.44	3.91	4.19
CD (P=0.05)	7.17	11.48	12.29

Table 3: Effect of integrated nutrient management on bulb weight (g)

Treatment	Bulb Weight (g)
T_1	37.57
T_2	48.81
T_3	46.21
T_4	52.04
T_5	42.41
T_6	48.75
T_7	45.76
T_8	51.01
T_9	44.50
T_{10}	47.65
T_{11}	42.58
T_{12}	49.82
SEm±	1.90
CD (P=0.05)	5.57

Table 4: Effect of integrated nutrient management on yield per plot

Treatment	Yield per plot (kg)	Yield per hectare (t)
T_1	2.71	8.35
T_2	3.51	10.85
T_3	3.33	10.27
T_4	3.75	11.56
T_5	3.05	9.42
T_6	3.51	10.83
T_7	3.29	10.17
T_8	3.67	11.34
T_9	3.20	9.89
T_{10}	3.43	10.59
T_{11}	3.07	9.46
T_{12}	3.59	11.07
SEm±	0.14	0.42
CD (P=0.05)	0.40	1.24

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