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Plant Growth Improvement in Ridge Gourd through Integrated Nutrient Management Practices

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ABSTRACT

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A field experiment was conducted during Zaid-2017 and 2018 to study the “Effect of integrated nutrient management on plant growth improvement of ridge gourd.” at Horticulture farm, SKN College of Agriculture, Jobner, Rajasthan. There were twenty four treatment combinations replicated thrice in a randomized block design. The result of the experiment showed that the plant growth of ridge gourd was significantly increased with integrated use of manure, fertilizers and bio-fertilizer. Integration of vermicompost with inorganic fertilizers and microbial inoculants has efficiently contributed in mineralisation of unavailable forms of nutrient to the available form. The results revealed that the vines of ridge gourd fertilized with 100% of RDF of NPK + vermicompost @ 8.3 t/ha and Azotobacter + PSB recorded maximum vine length, number of branches per plant, leaf area and total chlorophyll content alongwith early initiation of first female and male flowers and maximum number of female and male flowers per vine. Hence, the above integration is essential for improving growth parameters of ridge gourd grown in sandy loam soils of Rajasthan.

Introduction

Ridge gourd (*Luffa acutangula* L.) is one of the important tropical cucurbitaceous vegetable grown throughout India and South-East Asia which belong to genus *Luffa*. It is a vegetable of commercial importance and green immature fruits are cooked as vegetable. Ridge gourd is also called turiya or even turai or beerakai or dodka in several languages in India.

The chemical constituents of ridge gourd fruits include carbohydrates, carotene, fat, protein, phytin, flavonoids, saponin and amino acids. Kandlakunta *et al.*, (2008) reported that ridge gourd contains about 300 µg β-carotene and 1000 µg carotenoids per 100 g of fresh fruits. It has various pharmacological activities like hepatoprotective, antidiabetic, antioxidant, abortifacient and antifungal activity. Ridge gourd is an excellent blood purifier,

possessing laxative properties, cure for jaundice, aiding weight loss, anti-inflammatory and antibiotic, fortifying the immune system, skin cure and good for stomach.

It is a climber, stem acutely 5 angled, hairy tendrils, leaves 5-7 angled or shallowly lobed. The sex forms in ridge gourd are monoecious, androecious, gynoecious, gynomonoecious, andromonoecious and hermaphrodite.

The continuous use of high level of chemical fertilizers leads to decrease the nutrient uptake efficiency of plants, resulting in either stagnation or decrease in yield and also causing environmental pollution (Singh and Kalloo, 2000). Hence integrated supply of nutrients through organic, inorganic and bio-fertilizers is the need of the hour for sustainable productivity and to maintain better soil health.

Application of eco-friendly bio-fertilizers and low cost input with organic and inorganic fertilizers play significant role in plant nutrition. Integrated nutrient management involves judicious use of organic, inorganic and biofertilizers, which ultimately cause a significant reduction in chemical fertilizers.

It also help in ecological safety, exploitation of local resources ensuring higher soil and crop productivity to overcome micronutrient deficiencies and increase efficiency of applied fertilizer (Johan *et al.*, 2001).

Therefore, the present experiment was undertaken to study the effect of integrated nutrient management on plant growth improvement of ridge gourd.

Materials and Methods

The experiment was conducted during zaid seasons of the year 2017 and 2018 at Horticulture farm, SKN College of

Agriculture, Jobner, Rajasthan with variety pusanutan following the randomized block design with twenty four treatments which were replicated thrice. The treatments were three levels of inorganic fertilizers (75%, 100% and 125 % RD of NPK), two organic manures (FYM @ 20 t/ha and vermicompost @ 8.3 t/ha) and four biofertilizers (No inoculation, inoculation with *Azotobacter*, PSB and *Azotobacter* + PSB).

The recommended dose of NPK for ridge gourd crop is 100:40:40 kg ha⁻¹. Full dose of P as single super phosphate and K as muriate of potash and half dose of N as urea was applied on the day of sowing and rest of half dose of N at 25 DAS. *Azotobacter* and PSB was applied as seed treatment @ 70 ml kg⁻¹ of seed. Farm yard manure and vermicompost were applied as per treatment schedule. The seeds were sown in mid of February during both the years. The seeds of cv. PusaNutan were sown manually by hand method at a distance of 2.50 m x 0.50 m between row and plant, respectively using seed rate of 3 kg ha⁻¹ at a depth of 4-5cm.

The observations regarding the growth parameters viz., vine length, number of primary branches per vine, days taken to first male and female flower initiation, number of male and female flowers and chlorophyll content of leaves were recorded from five representative plants except leaf area from each plot. The leaf area of one plant was obtained from each plot at 50 DAS by leaf area meter (LICOR-3100, Lincoln, USA) and chlorophyll content of ridge gourd leaves at 50 DAS stage was estimated by the method as advocated by Arnon (1949).

Results and Discussion

Vine Length (cm)

Progressive increase in recommended dose of

inorganic fertilizers from 75 to 125 per cent brought about significant improvement in vine length of ridge gourd (Table-1). The maximum mean vine length (57.51 and 190.69 cm) was recorded under application of 125 % RDF being statistically at par with 100 % RDF (F₂). Treatment F₃ and F₂ registered 7.01 and 5.40 per cent increase in vine length over F₁, respectively at 60 DAS stage. The increase in vine length in vermicompost was registered to the tune of 4.78 per cent over FYM. The combined application of *PSB* and *Azotobacter* recorded the significantly maximum increase in vine length over no inoculation and use of *PSB* and *Azotobacter* alone, respectively to the tune of 13.96, 8.23 and 7.36 percent.

Number of primary branches

Data pertaining to number of primary branches among inorganic fertilizers, maximum number of primary branches (3.53) was observed in 125 % RDF followed by 3.48 and 3.30 in 100 % and 75 % RDF, respectively (Table-1). The application of vermicompost @ 8.3 t ha⁻¹ (M₂) significantly improved number of primary branches to the extent of 5.07 per cent over FYM application. The maximum mean number of primary branches (4.77) was achieved with the combined use of *PSB* and *Azotobacter* which led to an increase of 105.60, 50 and 37.07 per cent over control, *PSB* and *Azotobacter*, respectively.

Leaf area (cm²)

Application of 125 % RDF registered an increase of 7.01 per cent higher leaf area over 75% RDF (Table-1). The application of vermicompost @ 8.3 t ha⁻¹ registered highest leaf area to the tune of 4.79 per cent over FYM. The maximum leaf area of 3757 cm² was also achieved with the combined inoculation of *PSB* + *Azotobacter* which had

an increase of 17.52, 12.86 and 10.86 per cent over control, *PSB* and *Azotobacter*, respectively.

Chlorophyll content in leaves (mg g⁻¹)

The mean maximum chlorophyll content in leaves (1.312 mg g⁻¹) was observed with 125 % RDF followed by 100 % RDF (1.292 mg g⁻¹) being at par with each other (Table-1). Application of vermicompost @ 8.3 t ha⁻¹ increased the chlorophyll content by 4.81 per cent in pooled analysis over FYM @ 20 t ha⁻¹. The increase in the chlorophyll content under combined inoculation of *PSB* and *Azotobacter* was registered to the tune of 8.14 and 5.31 per cent, respectively over no inoculation and inoculation with *PSB* alone in pooled analysis.

Days taken to first female and male flower initiation

The F₃ (125 % RDF) and F₂ levels (100 % RDF) were significantly superior over F₁ (75 % RDF) in reducing the period of appearance of first female and male flower (Table-2). There were no significant differences between F₃ and F₂. The female and male flowers were produced slightly earlier in vermicompost @ 8.3 t ha⁻¹ (M₂) as compared with FYM 20 t ha⁻¹. However, use of *PSB* and *Azotobacter* singly or in combination were produced significantly early first female and male flowers.

Number of female and male flowers per vine

The highest (16.91) number of female and male flowers was recorded with F₃ level (125 % RDF) followed by F₂ (100 % RDF) whereas, least was recorded in F₁ (75 % RDF). However, treatment F₃ was found statistically at par with F₂ (100 % RDF). The application of vermicompost @ 8.3 t ha⁻¹

significantly increased the number of female and male flowers on vine of ridge gourd over FYM @ 20 t ha⁻¹. The maximum number of female flowers (19.01) and male flowers (61.19) were recorded in combined inoculation of PSB and *Azotobacter* (Table-2).

Application of increasing levels of fertility may be attributed to better nutritional environment in the root zone as well as in the plant system. It is well established that nitrogen is the most indispensable of all mineral nutrients for growth and development of the plant as it is the basis of fundamental constituents of all living matter.

It also plays an important role in plant metabolism by virtue of being an essential compound like amino acids, protein, nucleic acids, enzymes, co-enzymes and alkaloids (Anjanappa *et al.*, 2012). Further, urea fertilizers in split doses might have helped to the requirement of the crop which resulted into the increase in the length of the vine. Similar findings were also reported by Kameswari *et al.*, (2011).

The possible reason for this acceleration of growth might be due to the activation of cell division and cell elongation in the axillary buds, which had a promoting effect in increased vein length, length of internode and number of laterals might be due to well established root system in addition to increased plant height and number of branches and leaves. Baghel *et al.*, (2017) reported significant increase in number of leaves due to combined application of chemical fertilizers and organic fertilizers. These findings are in close conformity with those of Singh *et al.*, (2018) in cucumber. The positive influences in growth parameters are associated with the release of macro and

micro nutrients during the course of microbial decomposition (Singh and Ram, 1982). The improvement in vine length, number of primary branches and leaf area with application of organic manures might be due to better moisture holding capacity and availability of major and micro nutrients due to favorable soil conditions (Reddy *et al.*, 1998).

The better growth of plant in terms of dry matter accumulation could also be attributed due to enhanced release of micronutrients from the added source of N, P and K as well as release of nutrients on mineralization and changes in the physico-chemical properties of soil due to application of organic carbon in the form of vermicompost thereby improvement in soil nutrients status.

The interactive influence of mineral nutrients and vermicompost on growth might be due to improved physico-chemical and biological properties like water holding capacity, hydraulic conductivity, high rate of microbial transformations which make availability of organic carbon in the form of vermicompost for heterotrophic organisms. It might act as stimulant for supply of crop nutrients during the course of decomposition. Vermicompost being a rich source of micro nutrients like Zn, Fe, Cu and Mn are involved in synthesis of plant hormones like auxin (IAA) through tryptophan pathway.

Further, vitamins, minerals and phytohormones like auxin and other growth regulators and its decomposition products may give rise natural complexing agents that solubilize the nutrients already present in soil and available to the plant (Kharga *et al.*, 2019). Application of *Azotobacter* improves nitrogen status of the soil because it is free nitrogen fixers.

Table.1 Effect of integrated nutrient management on vine length, number of primary branches, leaf area and total chlorophyll content of ridge gourd

Treatments	Vine length (cm) at 60 DAS	No. of Primary branches	Leaf area (cm ²)	Total chlorophyll (mg/g)
F₁ -75% RD of NPK	178.19	3.30	3282	1.226
F₂ - 100% RD of NPK	187.82	3.48	3459	1.292
F₃ - 125% RD of NPK	190.69	3.53	3512	1.312
SEm_±	2.49	0.04	45	0.017
CD (P=0.05)	6.98	0.12	128	0.048
M₁- FYM (20 t/ha)	181.24	3.35	3338	1.247
M₂- VC (8.3 t/ha)	189.90	3.52	3498	1.307
SEm_±	2.03	0.03	37	0.014
CD (P=0.05)	5.70	0.10	104	0.040
B₀ - No inoculation	174.49	2.32	3197	1.228
B₁ - Azotobactor	185.22	3.48	3389	1.291
B₂ - PSB	183.73	3.18	3329	1.261
B₃ - Azotobactor + PSB	198.85	4.77	3757	1.328
SEm_±	2.87	0.05	52	0.020
CD (P=0.05)	8.06	0.14	147	0.056

Table.2 Effect of integrated nutrient management on Days taken to 1st female flower initiation, Days taken to 1st male flower initiation and No. of female flowers and male flowers

Treatments	Days taken to 1 st female flower initiation	Days taken to 1 st male flower initiation	No. of female flowers	No. of male flowers
F₁ -75% RD of NPK	37.83	32.07	15.80	54.75
F₂ - 100% RD of NPK	33.66	28.54	16.66	57.71
F₃ - 125% RD of NPK	32.92	27.92	16.91	58.59
SEm_±	0.54	0.46	0.22	0.76
CD (P=0.05)	1.50	1.29	0.60	2.14
M₁- FYM (20 t/ha)	35.35	29.97	16.07	55.68
M₂- VC (8.3 t/ha)	34.26	29.05	16.84	58.34
SEm_±	0.44	0.37	0.18	0.62
CD (P=0.05)	NS	NS	0.49	1.75
B₀ - No inoculation	37.30	32.13	14.33	53.96
B₁ - Azotobactor	34.92	29.85	16.54	56.84
B₂ - PSB	34.42	29.29	15.96	56.07
B₃ - Azotobactor +	32.58	26.78	19.01	61.19
SEm_±	0.62	0.53	0.25	0.88
CD (P=0.05)	1.74	1.49	0.70	2.47

Efficient and healthy strain of *Azotobacter* rhizosphere, which in turn have resulted in greater fixation of atmospheric nitrogen and consequently use by the plant resulting in vigorous growth of it. Similar results have been reported by Sarhan *et al.*, (2011) in summer squash, Isfahani and Besharati (2012), Thriveni *et al.*, (2017) in bitter gourd. Phosphate Solubilizing Bacteria (PSB) when inoculated, secrete anti-biotic substances and solubilize the otherwise unavailable insoluble soil phosphorus and then make it available to the plant.

The inoculation of PSB bio-fertilizer increases the yield of crops by 10 to 30 per cent (Tilak and Annapurna, 1993). Results of present investigation showing that use of these bio-fertilizers significantly improved growth parameters. However, the improvement in these characters were found limited when these bio-fertilizers were used singly, but the additive effect noticed when PSB and *Azotobacter* were used together. Such an additive influence of bio-fertilizers may attributable to mutually beneficial role played by each of the two groups of bio-fertilizers used. These findings have been weighted by Thriveni *et al.*, (2017) in bitter gourd, Ghayal *et al.*, (2018) in cucumber.

Integration of vermicompost with inorganic fertilizers and microbial inoculants has efficiently contributed in mineralisation of unavailable forms of nutrient to the available form. Biofertilizers like *Azotobacter* and PSB has provided aids in solubilisation and translocation of nutrients to the vines further resulting in high yield with enhanced fruit quality. From the present investigation, it was concluded that the integration of 100% of RDF of NPK + vermicompost @ 8.3 t/ha + *Azotobacter* + PSB was witnessed to be the best INM approach for plant growth improvement of ridge gourd.

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