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Impact of Chemical Fertilizers, Organic Manure and Bio-inoculants on Sustainable Production of Onion (*Allium cepa* L.)

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ABSTRACT: The impact of chemical fertilizers, organic manure and bio-enhancer focuses at efficient and judicious use of the main sources of plant nutrients. It is done in a balance manner so as to get maximum economic yield without any deleterious effect which is affecting the physical, chemical and biological properties of the soil. Only some experimental studies have been done in onion for chemical fertilizers, organic manure and bio-enhancer. With this background an experiment was conducted at the agriculture farm (Rajaula) of Mahatma Gandhi Chitrakoot Gramodaya Vishwavidyalaya, Chitrakoot, Satna (M.P.) during 2019. The experiment was laid out in Randomized Block Design (RBD) having fourteen treatments replicated thrice. As per the findings, significantly higher bulb diameter (6.10 cm), bulb length (6.37 cm), bulb weight (60.63), bulb ring (7.33), yield ha^{-1} (24.50 q) was recorded with treatment T_{11}-(25% N equivalent from organic source + 75% RDF (NPK 75:60:60 kg ha^{-1}) + Bio-fertilizer consortium (Azotobacter + PSB) and Bio-enhancer Seedling treatment (panchgavya) spray at 15 days interval from 20 days), which was at par with application of T_2 (R.D.F. NPK 100:80:80 kg ha^{-1}). Maximum plant height 90 DAS (65.93 cm), Number of leaves 90 DAS (7.20) and leaves length 90 DAS (53.50 cm) was recorded with application of T_2 (R.D.F. NPK 100:80:80 kg ha^{-1}) which was followed by application of T_{11}-(25% N equivalent from organic source + 75% RDF (NPK 75:60:60 kg ha^{-1}) + Bio-fertilizer consortium (Azotobacter + PSB) and Bio-enhancer Seedling treatment (panchgavya) spray at 15 days interval from 20 days). The results showed that application of T_{11}-(25% N equivalent from organic source + 75% RDF (NPK 75:60:60 kg ha^{-1}) + Bio-fertilizer consortium (Azotobacter + PSB) and Bio-enhancer Seedling treatment (panchgavya) spray at 15 days interval from 20 days), this treatment proved to be promising for the enhancement the yield of onion under the Bundelkhand Agro-climatic condition.

Keywords: Bio-enhancer, Bio-fertilizer, Growth, Onion, panchgavya, Sustainability and Yield.

INTRODUCTION

Onion (*Allium cepa* L.) is a grandly bulb crop of India, broadly cultivated throughout India for its high nutritional and medicinal properties. It is also called "Queen of Kitchen" (Selviraj, 1976) and is richly used as salad, cooked in curries, boiled, fried, baked and picked. Onion is a stimulant, diuretic and has expectorant and antibacterial properties. It prevents heart disease by lowering blood cholesterol and lipid level (Sharangi & Datta 2005). With 31.77 MT of onion production from a 26.64 MH area in 2021-22 (NHB-2021), India is the second largest onion producer in the World after China. In India, the share of Maharashtra in the total onion production is around 38.06% in contrast to Madhya Pradesh contributing only 15.23% (Anonymous, 2021). FYM is the generally used organic manure but its supply is moderate and contains low and varied nutrient concentration. Mixed usage of FYM and inorganic fertilizers is of special importance under intensive cropping system as these are complementary and supplementary to each other in sustaining crop yield and soil productivity.

Use of biofertilizers not only supplement the nutrients but also improve the efficiency of applied nutrient (Somani *et al.*, 1990). Bio fertilizers play key role in increasing the availability of nutrient. Inoculation of these bio-fertilizers in very small quantity supplemented with sufficient amount of organic matter converts the insoluble and unavailable from of nutrient in soluble and available form of nutrients. Studies have also shown that integrated use of chemical fertilizers, organic residues such as FYM, compost etc. and biofertilizers resulted in reduced losses of nutrients and environment pollution (Ange and Norbu 1993). The combination application of organics such as FYM,

compost, green manure, etc. and liquid organic organics *viz*., Jeevamrut, Beejamurut, Panchagavya, Gomutra, Angara etc. which content microbial count and plant growth promoting substances (PGPR) stimulate growth, yield and quality of crops. Panchagavya, Jeevamruth and Beejamruth are cheaper ecofriendly organic preparations made by cow products namely dung, urine, milk, curd and ghee. The Panchagavya is an efficient plant growth stimulant that enhances the biological efficiency of crops. Further it helps to build soil organic matter status besides minimizing the cost of cultivation. Generally, onion is cultivated in *Rabi* and *Kharif* season. There is an ample scope for increasing quality production by proper management of inorganic fertilizers, organic manure and biofertilizer inoculations. Panchagavya a promising natural liquid manure id bring used by many organic farmers in many crops in different part of our country (Anonmoues, 2005). Since, onion being a major spice with tremendous export potential, the emphasis needs to be given for increasing the quality apart from productivity and both can be achieved by optimum and balanced supply of all the plant required nutrients. Application of FYM improves quality of onion by enhancing ascorbic acid content (Chavan *et al*., 1997), oleoresin content observed an improvement quality of onion due to panchagavya spray. In this context, it is felt is that organic nutrient is a remedy to manage the unhealthy effect of chemical farming so as to manage soil health for sustaining the soil productivity and quality of onion.

METHOD AND MATERIAL

The present investigation to impact of chemical fertilizers, organic manure and bio-inoculants on sustainable production of onion (*Allium cepa* L.) was conducted during 2019 at Mahatma Gandhi Chitrakoot Gramodaya Vishwavidyalaya, Chitrakoot – Satna (Madhya Pradesh), located in Chitrakoot in Satna district of Madhya Pradesh. Chitrakoot is located between 24° 48′ to 25° 12′ North latitude and 80° 58′ to 81° 34′ East longitude at an elevation of 140 m above MSL. The soil of the experimental field was sandy loam in texture and having pH 7.70, EC 0.0.28 dSm^{-1}, organic carbon content 0.41%, low in available N (214 kg/ha), medium P (20.72 kg/ha) and medium in K (223.34 kg/ha). The experiment was laid out in randomized block design with three replications. The treatments comprised of organic, inorganic fertilizer and bio-inoculants with fourteen treatments T_1 - F. Y. M. @ 20 tans ha^{-1}, T_2 - R.D.F. (NPK 100:80:80 kg ha^{-1}), T_3 - SPNF (Subhas Palekar Natural Farming) Seedling treatment with Bijamrat + soil application of jivamrat 3 times 1+2 as irrigation at 30 days interval, T_4 -Bio-fertilizer consortium (Azotobacter + PSB) and Bio-enhancer Seedling treatment (panchgavya) spray at 15 days interval from 20 days, T_5 -50% F.Y.M. + 50% RDF (NPK 50:40:40 kg ha^{-1}), T_6 -50% F.Y.M. + T_4, T_7 -50% RDF (NPK 50:40:40 kg ha^{-1}) + T_4, T_8 -25% N equivalent from organic source + 75% RDF (NPK 75:60:60 kg ha^{-1}), T_9 -25% N equivalent from organic source + T_4, T_{10} -T_5 (50% N equivalent from organic source + 50% from chemical) + T_4, T_{11} - T_8 + T_4, T_{12} - SPNF (Subhas Palekar Natural Farming) + T_4, T_{13} - F. Y. M. @ 20 tans ha + T_4 and T_{14} - Farmer practice (F.Y.M. @ 10 tons ha + urea + DAP (Approx 100: 40). The treatments of manure, chemical fertilizers and bio-enhancer were applied as per treatment in respective plot. FYM were applied prior to 21 days of transplanting of Onion. PSB and Azotobactor bio-fertilizer was applied at the time of transplanting. Inorganic fertilizer i.e., DAP, Urea and Murate of Potash were applied as a basal dose during transplanting whereas as 1/2 dose of urea was applied at the time of transplanting and remaining 1/4 – 1/4 dose applied at 30 and 60 days of transplanting respectively. The seeds of onion variety "Agrifound Dark Red" were treated with azotobacter + PSB (SAAF) @ 2.5 gm kg^{-1} before sowing in nursery. The seed of onion variety Agrifound Dark Red was raised in the nursery of 3 m long and 1.2 m wide and 10 cm above the ground level was prepared and manure as per the recommendation treatments. Treated seed were sown on 23 June 2019 in line and all the intercultural operations were done as and when required. 45 days old seedlings of uniform size were transplanted on 07 August, 2019 in the prepared field. The spacing 15 cm row to row and 10 cm plant to plant was maintained. The seedlings were transplanted in cool evening according to the layout plan. A light irrigation was applied just after the transplanting and subsequent irrigation was given at an interval of 10-12 days depending upon the soil condition. Harvesting of onion was done on 20 November 2019. The plant height, No. of leaves, leaves length, diameter of bulb (cm), bulb weight (g), bulb length, bulb ring and bulb yield (q ha^{-1}) parameters were recorded and thereafter, tabulated and analyzed statistically by method of analysis of variance. The data were analyzed statistically and results were interpreted by using methods suggested by Fisher (1958).

RESULT AND DISCUSSION

A. Growth parameters

Plant height. The data are presented in Table 1 clearly indicates that the height of the plant respective of the treatment. All the treatment exhibited a significant difference when compared with traditional farming practices. The plant height ranged from 26.73 cm to 36.70 cm, 37.57 cm to 45.30 and 54.33 cm to 65.93 cm at 30, 60, and 90 Days after planting. At final stages of growth, the maximum plant height 65.93 cm was recorded with the treatment T_2 followed by T_{11} 65.43 cm.

Number of leaves per plant. The average number of leaves per plant were recorded at three successive stages of growth leaves are the workshop of the plant as they manufacture the carbohydrate for proper functional and the health of the plants when growth cease the accumulated carbohydrates translocate to the yield contributing factors which ultimately affects the yield of the plants. Thus, the more number of leaves may produce more carbohydrate for its survival. The data are presented in Table 2 clearly shows that the number of leaves per plant respective of the treatment. The average number of leaves rainfed condition maximum

4.47, 5.50 and 7.20 minimum 3.0, 3.77 and 5.27 and into 30, 60 and 90 T_2 days after transplanting the minimum number of leaves were recorded under plants 3.0, 3.77, and 5.27 T_{12}.

Size of leaves length. It is revealed from the data values presented in Table 3 that there were a significant difference among the treatments and also with the comparison of T_{14}. The treatment T_2 was applied significantly increased the length of leaves. It was followed by some other treatment like T_{12}, T_{11}, T_8, T_7. But all were statistically at par when compared with each other. The shortest leaves were identified with the traditional farming practice (T_{14}).

B. Yield parameters

Bulb diameter and bulb length. The data relating to length of bulb (cm) are presented in Table 4, which clearly shows that effect organic manure, chemical fertilizers and bio-enhancer significantly influenced the length of bulb (cm). The maximum length of bulb (6.37 cm) was recorded in the treatment T_{11} followed by T_1, T_4, T_5, T_8, T_9, T_{10}, T_{12} and T_{13}. Whereas the minimum length of bulb (4.07 cm) was found in T_{14}.

Bulb weight and bulb ring. Significantly maximum bulb weight of bulb and bulb ring was exhibited in the treatment T_{11} (25% N equivalent from organic source + 75% RDF (NPK 75:60:60 kg ha^{-1}) + Bio-fertilizer consortium (Azotobacter + PSB) and Bio-enhancer Seedling treatment (panchgavya) spray at 15 days interval from 20 days) followed by T_2 (R.D.F. NPK 100:80:80 kg ha^{-1}), bulb weight of bulb and bulb ring differed significantly due to application of FYM, biofertilizers, chemical fertilizers and bio- enhancer significantly increased the of bulb weight of bulb and bulb ring onion.

Yield ton ha^{-1}. The treatment T_{11} (25% N equivalent from organic source + 75% RDF (NPK 75:60:60 kg ha^{-1}) + Bio-fertilizer consortium (Azotobacter + PSB) and Bio-enhancer Seedling treatment (panchgavya) spray at 15 days interval from 20 days) recorded significantly maximum average yield ton ha^{-1} (22.67) which was on par with the treatment T_2 (R.D.F. NPK 100:80:80 kg ha^{-1}), (24.42). Whereas, the treatment T_{14} (Farmer practice F.Y.M. @ 10 tons ha + urea + DAP Approx 100: 40) recorded minimum average yield $plot^{-1}$ and yield ton ha^{-1} (19.67). It might be due to the activities of FYM, biofertilizers, chemical fertilizers and bio-enhancer. Increased yield $plot^{-1}$ and yield ton ha^{-1} resulted in maximum. The experimental results are in accordance with the findings of Chaudhary *et al.* (2018), Gurjasr *et al*. (2022), Kaushik and Singh (2020) in onion.

DISCUSSION

In yield and yield attributing characters with applying nutrients through FYM and fertilizers might be attributed to the fast release and availability of nutrients in the required quantity with the application of fertilizers. Further, FYM acts as store house for various micro and macro nutrients that are released during the process of mineralization and increase the soil porosity which increases soil aeration leading to better soil productivity Mahajan *et al*. (2008) showed that the nutrients provided through inorganic sources enhanced yield initially but led to unsustainable productivity over the years. Bokhtiar & Sakurai (2005) that the use of unevenness nutrients through chemical fertilizer in continuous cropping leads to an imbalance of nutrients in the soil, leaching of N, contamination of water resources, destruction of microorganisms and friendly insects, crop penetrability to disease outbreak, soil degradation, or decreased soil fertility thus bringing permanent loss to the whole system. This is due to their susceptibility to losses in gaseous forms or by leaching when applied at a wrong time or in an excess amount beyond the plant demand. The ill effects of inorganic fertilizer coupled with their high costs have incited the interest for the utilization of organic fertilizer as a source of nutrients. Soil application of Jivamrit additionally might increase water-holding capacity of soil which helped the crop to utilize water during pre- and post-monsoon periods. Along with these organic formulations, FYM was applied additionally at basal which might help in the early decomposition and quick release of nutrients at initial growth of the plants. The sufficient supply of nutrients over a longer period of time might not only facilitate the photosynthesis of the crop but also the translocation of photo-assimilates to economic parts *i.e.* corm. Corm treatment with Beejamrit + soil application of Jiwamrit (T_9) outperformed others as both the formulations were possibly rich in macro and micro-nutrients, vitamins, amino acids, growth regulators and served as storage media for the significant microorganisms. In soil, they perhaps positively influenced soil microbial activity for sustainable supply of nutrients to EFY. Greater N availability and uptake might trigger the leaf chlorophyll synthesis for capturing more sunlight and CO_2 resulting in more photosynthesis, dry matter production and superior vegetative growth.

Table 1: Impact of chemical fertilizers, organic manure and bio-inoculants on sustainable production of onion (*Allium cepa* L.) Plant height.

Sr. No.	Treatment combination	Plant height cm.		
		At 30 DAT	At 60 DAT	At 90 DAT
T_1	F. Y. M. @ 20 tans ha^{-1}	31.17	42.53	61.90
T_2	R.D.F. (NPK 100:80:80 kg ha^{-1})	36.70	45.30	65.93
T_3	SPNF (Subhas Palekar Natural Farming) Seedling treatment with Bijamrat + soil application of jivamrat 3 times 1+2 as irrigation at 30 days interval	30.47	41.93	61.33
T_4	Bio-fertilizer consortium (Azotobacter + PSB) and Bio-enhancer Seedling treatment (panchgavya) spray at 15 days interval from 20 days	29.93	41.73	60.87
T_5	50% F.Y.M. + 50% RDF (NPK 50:40:40 kg ha^{-1})	32.90	43.40	62.87
T_6	50% F.Y.M. + T_4	27.67	40.17	58.80
T_7	50% RDF (NPK 50:40:40 kg ha^{-1}) + T_4	33.50	44.00	64.53
T_8	25% N equivalent from organic source + 75% RDF (NPK 75:60:60 kg ha^{-1})	34.83	44.57	59.83
T_9	25% N equivalent from organic source + T_4	28.74	41.70	58.97
T_{10}	T5 (50% N equivalent from organic source + 50% from chemical) + T_4	34.00	44.27	64.80
T_{11}	T_8 + T_4	35.27	45.17	65.43
T_{12}	SPNF (Subhas Palekar Natural Farming) + T_4	32.70	43.27	62.80
T_{13}	F. Y. M. @ 20 tans ha + T_4	31.73	42.87	62.73
T_{14}	Farmer practice (F.Y.M. @ 10 tons ha + urea +DAP (Approx 100: 40)	26.73	37.57	54.33
	F-test	**S**	**S**	**S**
	S.Ed. (±)	**1.36**	**1.22**	**0.66**
	C.D. at 5%	**3.98**	**3.57**	**1.92**

Table 2: Impact of chemical fertilizers, organic manure and bio-inoculants on sustainable production of onion (*Allium cepa* L.) number of leaves.

Sr. No.	Treatment combination	No. of leaves		
		At 30 DAT	At 60 DAT	At 90 DAT
T_1	F. Y. M. @ 20 tans ha^{-1}	3.23	4.20	6.07
T_2	R.D.F. (NPK 100:80:80 kg ha^{-1})	4.47	5.50	7.20
T_3	SPNF (Subhas Palekar Natural Farming) Seedling treatment with Bijamrat + soil application of jivamrat 3 times 1+2 as irrigation at 30 days interval	3.23	4.10	6.03
T_4	Bio-fertilizer consortium (Azotobacter + PSB) and Bio-enhancer Seedling treatment (panchgavya) spray at 15 days interval from 20 days	3.20	4.07	6.00
T_5	50% F.Y.M. + 50% RDF (NPK 50:40:40 kg ha^{-1})	3.50	5.03	6.23
T_6	50% F.Y.M. + T_4	3.03	4.00	5.43
T_7	50% RDF (NPK 50:40:40 kg ha^{-1}) + T_4	3.03	5.07	6.33
T_8	25% N equivalent from organic source + 75% RDF (NPK 75:60:60 kg ha^{-1})	3.63	5.23	6.93
T_9	25% N equivalent from organic source + T_4	3.13	4.03	5.87
T_{10}	T5 (50% N equivalent from organic source + 50% from chemical) + T_4	3.70	5.23	6.83
T_{11}	T_8 + T_4	4.17	4.43	7.07
T_{12}	SPNF (Subhas Palekar Natural Farming) + T_4	3.40	4.43	6.16
T_{13}	F. Y. M. @ 20 tans ha + T_4	3.33	4.33	6.13
T_{14}	Farmer practice (F.Y.M. @ 10 tons ha + urea +DAP (Approx 100: 40)	3.00	3.77	5.27
	F-test	**S**	**S**	**S**
	S.Ed. (±)	**0.22**	**0.24**	**0.24**
	C.D. at 5%	**0.65**	**0.71**	**0.67**

Table 3: Impact of chemical fertilizers, organic manure and bio-inoculants on sustainable production of onion (*Allium cepa* L.) leaves length.

Sr. No.	Treatment combination	Leaves length cm.		
		At 30 DAT	At 60 DAT	At 90 DAT
T_1	F. Y. M. @ 20 tans ha^{-1}	28.40	40.73	48.83
T_2	R.D.F. (NPK 100:80:80 kg ha^{-1})	30.70	44.37	53.50
T_3	SPNF (Subhas Palekar Natural Farming) Seedling treatment with Bijamrat + soil application of jivamrat 3 times 1+2 as irrigation at 30 days interval	28.03	40.73	48.43
T_4	Bio-fertilizer consortium (Azotobacter + PSB) and Bio-enhancer Seedling treatment (panchgavya) spray at 15 days interval from 20 days	27.70	40.60	48.00
T_5	50% F.Y.M. + 50% RDF (NPK 50:40:40 kg ha^{-1})	29.30	41.30	51.63
T_6	50% F.Y.M. + T_4	27.10	40.27	47.63
T_7	50% RDF (NPK 50:40:40 kg ha^{-1}) + T_4	29.60	42.97	52.10
T_8	25% N equivalent from organic source + 75% RDF (NPK 75:60:60 kg ha^{-1})	30.10	43.83	52.88
T_9	25% N equivalent from organic source + T_4	27.30	40.40	47.67
T_{10}	T5 (50% N equivalent from organic source + 50% from chemical) + T_4	29.73	43.63	52.87
T_{11}	T_8 + T_4	30.33	44.30	52.89
T_{12}	SPNF (Subhas Palekar Natural Farming) + T_4	28.93	41.13	51.37
T_{13}	F. Y. M. @ 20 tans ha + T_4	28.57	41.03	50.43
T_{14}	Farmer practice (F.Y.M. @ 10 tons ha + urea +DAP (Approx 100: 40)	26.93	39.97	47.13
	F-test	**S**	**S**	**S**
	S.Ed. (±)	**1.19**	**0.99**	**0.70**
	C.D. at 5%	**3.49**	**2.90**	**2.05**

Table 4: Impact of chemical fertilizers, organic manure and bio-inoculants on sustainable production of onion (*Allium cepa* L.) bulb diameter and bulb length.

Sr. No.	Treatment combination	Bulb diameter	Bulb length
T_1	F. Y. M. @ 20 tans ha^{-1}	5.60	4.87
T_2	R.D.F. (NPK 100:80:80 kg ha^{-1})	6.07	6.17
T_3	SPNF (Subhas Palekar Natural Farming) Seedling treatment with Bijamrat + soil application of jivamrat 3 times 1+2 as irrigation at 30 days interval	5.30	4.03
T_4	Bio-fertilizer consortium (Azotobacter + PSB) and Bio-enhancer Seedling treatment (panchgavya) spray at 15 days interval from 20 days	5.30	4.73
T_5	50% F.Y.M. + 50% RDF (NPK 50:40:40 kg ha^{-1})	5.77	5.17
T_6	50% F.Y.M. + T_4	4.83	4.63
T_7	50% RDF (NPK 50:40:40 kg ha^{-1}) + T_4	5.80	5.37
T_8	25% N equivalent from organic source + 75% RDF (NPK 75:60:60 kg ha^{-1})	6.00	6.13
T_9	25% N equivalent from organic source + T_4	5.30	4.67
T_{10}	T_5 (50% N equivalent from organic source + 50% from chemical) + T_4	5.90	5.77
T_{11}	T_8 + T_4	6.10	6.37
T_{12}	SPNF (Subhas Palekar Natural Farming) + T_4	5.17	5.17
T_{13}	F. Y. M. @ 20 tans ha + T_4	5.61	5.07
T_{14}	Farmer practice (F.Y.M. @ 10 tons ha + urea +DAP (Approx 100: 40)	4.87	4.07
	F-test	**S**	**S**
	S.Ed. (±)	**0.23**	**0.22**
	C.D. at 5%	**0.68**	**0.65**

Table 5: Impact of chemical fertilizers, organic manure and bio-inoculants on sustainable production of onion (*Allium cepa* L.) bulb weight, bulb ring and yield.

Sr. No.	Treatment combination	Bulb weight	Bulb ring	Yield ton ha^{-1}
T_1	F. Y. M. @ 20 tans ha^{-1}	42.27	6.67	21.75
T_2	R.D.F. (NPK 100:80:80 kg ha^{-1})	54.80	7.33	24.42
T_3	SPNF (Subhas Palekar Natural Farming) Seedling treatment with Bijamrat + soil application of jivamrat 3 times 1+2 as irrigation at 30 days interval	41.83	6.33	20.75
T_4	Bio-fertilizer consortium (Azotobacter + PSB) and Bio-enhancer Seedling treatment (panchgavya) spray at 15 days interval from 20 days	38.37	6.33	20.33
T_5	50% F.Y.M. + 50% RDF (NPK 50:40:40 kg ha^{-1})	45.87	7.00	22.38
T_6	50% F.Y.M. + T_4	36.14	6.33	19.83
T_7	50% RDF (NPK 50:40:40 kg ha^{-1}) + T_4	47.40	7.00	22.58
T_8	25% N equivalent from organic source + 75% RDF (NPK 75:60:60 kg ha^{-1})	51.57	7.00	23.25
T_9	25% N equivalent from organic source + T_4	37.77	6.33	20.75
T_{10}	T_5 (50% N equivalent from organic source + 50% from chemical) + T_4	48.60	7.00	22.67
T_{11}	T_8 + T_4	60.63	7.33	24.50
T_{12}	SPNF (Subhas Palekar Natural Farming) + T_4	44.21	6.67	22.17
T_{13}	F. Y. M. @ 20 tans ha + T_4	43.26	6.67	21.75
T_{14}	Farmer practice (F.Y.M. @ 10 tons ha + urea +DAP (Approx 100: 40)	35.98	6.33	19.67
	F-test	**S**	**S**	**S**
	S.Ed. (±)	**0.72**	**0.48**	**23.22**
	C.D. at 5%	**2.09**	**1.40**	**67.78**

CONCLUSIONS

In view of experimental result obtained during the present investigation, treatment T_{11}- 25% N equivalent from organic manures source + 75% RDF (NPK 75:60:60 kg ha^{-1}) + Bio fertilizers consortium (Azotobacter + PSB) and Bio-enhancer Seedling treatment (Panchgavya) spray at 15 days interval from 20 days, emerged as superior over all other treatments, in relation to yield attributes of onion under the Bundelkhand Agro-climate condition.

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