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Keshav Kumar Jatav
Department of Horticulture, MJRP College of Agriculture & Research, MJRP University, Jaipur, Rajasthan, India

RS Dhaka
Department of Horticulture, MJRP College of Agriculture & Research, MJRP University, Jaipur, Rajasthan, India

Uma Shankar Tanwar
Assistant Professor, Govt. Agriculture College, Behrawanda, Sikrai, Dausa, Rajasthan, India

Gyan Prakash Sharma
Department of Horticulture, MJRP College of Agriculture & Research, MJRP University, Jaipur, Rajasthan, India

Pawan Choudhary
Research Scholar, Sabarmati University (Formerly Calorx Teachers' University), Ahmedabad, Gujarat, India

Vijay Singh Meena
Assistant Professor, Govt. Agriculture College, Bharatpur, Rajasthan, India

Corresponding Author:
Uma Shankar Tanwar
Assistant Professor, Govt. Agriculture College, Behrawanda, Sikrai, Dausa, Rajasthan, India

Effect of organic manures and biofertilizers on growth and yield of *kharif* onion

Keshav Kumar Jatav, RS Dhaka, Uma Shankar Tanwar, Gyan Prakash Sharma, Pawan Choudhary and Vijay Singh Meena

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Abstract
A field experimented was conducted at Agronomy Farm, MJRP College of Agriculture and Research, Achrol, Jaipur to study the effect of organic manures and biofertilizers on growth and yield of *Kharif* onion. The results reveals that application of FYM 5 t ha^{-1} + Poultry Manures 2.5 t ha^{-1} along with inoculation with *Azospirillum* + PSB recorded significantly higher values of growth, yield attributes and yield of *kharif* onion. While, application of FYM 5 t ha^{-1} + Poultry Manures 2.5 t ha^{-1} was statistically at par with FYM @ 5 t ha^{-1} + 2.5 @ t ha^{-1} Vermicompost for growth characters.

Keywords: *Kharif* onion, vermicompost, poultry manure, bulb and biofertilizer

Introduction
Onion is one of the most important vegetables cum condiment crop grown throughout the world including India. Onion (*Allium cepa* L.) is a bulbous biennial herb of Alliaceae family. The edible portion is a modified stem, which is known as bulb and develops underground. Onion is one of the most important vegetable cash crops grown for vegetable in green stage and also for mature bulb. It is indispensable items in every kitchen as it adds flavor to various vegetable preparation, hence it is called "Queen of kitchen". It is a unique vegetable that is used throughout the year in the form of salad or condiments or for cooking with other vegetables. Onion is also used in preparing soups, sauces, curries, pickles and for flavouring or seasoning foods. Onion bulb has many medicinal properties. It is recommended for the persons suffering from high cholesterol, weakness, lethargy and lack of vitality. It increases the appetite and suppresses the formation of gases. Sunstroke, is the best remedy during summer. It is also useful in fever, dropsy, catarrh and chronic bronchitis. The pungency in onion is due to sulphur bearing compound "ally propyl disulphide" in the volatile oil and the outer skin colour is due to the presence of "querctin" (Nadkarni, 1954). Onion bulb are rich in minerals like phosphorus (50 mg/100 g), iron (0.7 mg/100 g), calcium (18 mg/100 g) and also contain carbohydrates (11.0 g/100 g), protein, (1.2 g/100 g) vitamins 'C' (11 mg/100 g), fibers (0.6 g/100 g) and nicotinic acid (0.4 mg/100 g) (Aykroyd, 1963)
The productivity of onion in India is very low (16 t ha^{-1}) in comparison to other countries. Thus, there is ample scope for increasing production through fertilizers, especially that of organic manures and biofertilizers in light textured soil. Organic manures like FYM stimulates the production of polysaccharides and other compounds that favours aggregation of fine soil particles, thereby promoting good structure, improved tilth, aeration, moisture movement and retention (Bose *et al*., 2001) [5].
Vermicompost has been advocated as good organic manure for use in the field crops and vegetables crops. use of vermicompost as an organic fertilizer and substitute for chemical fertilizer is advised by pioneers of organic farming. Earthworm processed organic waste, often referred to as vermicompost are finally divided peat like materials with high porosity, aeration, drain ability and water holding capacity. Vermicompost contains nutrients in the readily available from to the plants such as nitrate, exchange phosphorus, soluble potassium, calcium and magnesium (Edwards and Burrows, 1988) [11].

Poultry manure is an important source of nutrient and has direct effect on plant growth. It contains about 1.30 percent N, 1.80 percent P_2O_5 and 0.8 percent K_2O (Choudhary, 2006) [8]. Poultry manure also contains traces of micronutrients which are generally not supplied by the commercial fertilizers but essential for plant growth. It is well documented that it is an excellent source of organic manure which increase nutrients uptake (Jose *et al.,* 1988 and Abusaleha, 1992) [13, 1].

Atmosphere contains 78 percent nitrogen but the plants cannot take it directly from the atmosphere. However, some micro-organism fixes atmospheric nitrogen in the plant roots. It has been estimated that this biological fixation contributes to about 175 million tonnes of nitrogen annually (Meelu, 1996) [16]. Biofertilizers are the inoculation of microorganism, which are capable of mobilizing nutritive elements from non-usable form to usable form though biological process. They are cost effective and inexpensive source of plant nutrients, do not require non-renewable source of energy during their production, improve crop growth and quality of the product by producing plant hormones and help in sustainable crop production through maintenance of soil productivity. *Azospirillum* are a group of bacteria found in loose association with the root system of many crops plants, which is a type of symbiosis where the bacterial cells colonize the root cortical cells or the inner cellular spaces in the cortex. These bacteria grow better under reduced oxygen levels. They fix nitrogen from 10 to 40 kg ha^{-1}. *Azospirillum* inoculation helps the plants to attain better vegetative growth and also in saving inputs of nitrogenous fertilizers by 20-30 percent (Mohondas, 1999) [19]. Phosphate solubilizing bacteria (PSB) when inoculated, secret acetic substances and solubilizes the otherwise unavailable insoluble soil phosphorus. The inoculation with PSB biofertilizers increases the yield of crop by 10 to 30 per cent (Tilak and Annapurna, 1993) [33]. However, information regarding effect of organic manures and bio fertilizers on onion in Rajasthan is lacking. Keeping in view the above discussed facts of sufficient information and sparce related research, the present investigation was undertaken to find out the effect of organic manures and biofertilizers on growth and yield of *Kharif* onion.

Materials and Methods

An experiment was conducted during *kharif* season of 2017 at Agronomy Farm, MJRP College of Agriculture and Research, Achrol, Jaipur. The experiment was conducted in factorial randomized block design with replicate thrice consisted of six organic manures *viz.* control, FYM 10 t ha^{-1}, Vermicompost 5 t ha^{-1}, Poultry manure 5 t ha^{-1}, FYM 5 t ha^{-1} + vermicompost 2.5 t ha^{-1} and FYM 5 t ha^{-1} + poultry manure 2.5 t ha^{-1} as first factor while, three biofertilizers *viz.* control, *Azospirillum* and *Azospirillum* + PSB were used as second factor. Manures was applied before transplanting of seedling as per treatment. Seedlings were inoculated with *Azospirillum* and PSB culture or both as per treatment, using standard method and dried in shade. Biofertilizer i.e.- *Azospirillum* and PSB were applied as 100 g per acre culture dissolved of water and dipping the bulb of the onion in solution for 10-20 minutes before sowing (Paulet *et al.,* 1971). N-53 variety of onlion was used as a test crop. Twenty five days old seedlings were transplanted in main field. Other crop management methods were accompanied as per the recommendation of the area.

Statistical analysis and interpretation of data: Data recorded on various parameters of mustard crop in the experiment was subjected to analysis by using Fisher's method of analysis of variance (ANOVA) and interpreted as outlined by Gomez and Gomez (1984) [36]. The levels of significance used in 'F' and 't' test was p= 0.05. Critical difference values were calculated where F test was found significant.

Results and Discussions

Application of organic manures and biofertilizers exerted significant effect on growth characters (Table 1) of *kharif* onion at harvest stage.

Application of (T_4) FYM @ 5 t ha^{-1} + 2.5 @ t ha^{-1} Vermicompost recorded significantly higher plant height (63.58 cm), number of leaves $plant^{-1}$ (13.66) and fresh weight of leaves $plant^{-1}$ (63.10 g) which was statistically at par with (V_5) FYM 5 t ha^{-1} + Poultry Manures 2.5 t ha^{-1} over rest of the treatments. While, least values of growth characters were recorded under (V_0) Control treatment at harvest stage. Improvement in plant growth attributed might be due to the fact that FYM might have enhanced the soil microbial activity besides provide nutrients to the crop. Whereas application of vermicompost not only provided more readily available nutrients but also provided growth regulators and vitamins which might have interned in to higher improved the physical condition of soil in respect of granulation, friability and porosity and ultimately provided a balanced nutritional environment to the soil plant nutritional system (Kumar *et al*., 2003, Thanuhathan *et al.,* 1997 and Srivastava *et al.*, 2012) [14, 32, 29]. The significantly enhanced the vegetable growth due to the manorial fertilization to onion crop might be due to reduction in soil pH achieved due to of CO_2 and organic acid liberated during the course of decomposition (Maskina, 1979) [15] supplementation of naturally complexing agents to the soil plant nutrition system and increased soil biomass which might have solublized and increased availability of the native status of soil nutrients. These results are agreement with findings of Desi *et al*. (1965) [9] and Hari *et al.* (2009) [12].

In case of biofertilizers, significantly higher plant height (61.91 cm), number of leaves $plant^{-1}$ (13.41) and fresh weight of leaves $plant^{-1}$ (61.26 g) were recorded under inoculation with (B_{AP}) *Azospirillum* + PSB over rest of the treatments. This might be due to the PSB + *Azospirillum* might have improved both nitrogen and available phosphorus in rhizosphere as they are symbiotic nitrogen fixers and phosphate solubilizers, respectively. The combined inoculation of nitrogen fixer and PSB benefits the plant more than either group of organisms alone and might have added advantages in the degraded agro-ecosystem. These results are in close conformity with the findings Bareth (1998) [3] Muthuramalingam *et al*. (2001) [20] and Talwar *et al*. (2016) [31].

Manurial and biofertilizers application also exerted significant effect on yield attributes and yield of onion (Table 2). Among the organic manures, (V_5) FYM 5 t ha^{-1} + Poultry Manures 2.5 t ha^{-1} recorded significantly higher neck thickness of bulb (1.27 cm), bulb diameter (5.53 cm), fresh weight of bulb (109.67 g) and bulb yield (199.50 q ha^{-1}) which was statistically at par with application of (T_4) FYM @ 5 t ha^{-1} + 2.5 @ t ha^{-1} Vermicompost over rest of the treatments. While, least values of yield attributes and yield were recorded under (V_0) Control treatment during course of study. The increased yield and yield attributes with combined application of FYM @ 5 t ha^{-1} + poultry manure @ 2.5 t ha^{-1} might be due to increased favorable soil environment and developed in the application of FYM + poultry manure rapid availability and utilization of nitrogen for longer period various metabolisms plant processes for carbohydrates production. Later on these carbohydrates undergo hydrolysis and get converted in to reproductive which ultimately helped in increasing yield and may also be due to the increase rate of release of macro and

micronutrients during the course of microbial decomposition (Zarate *et al*., 1997) [33]. Organic matter also function as source of energy for soil microflora which bring about the transformation of inorganic nutrients held in soil or applied in the form of fertilizers in a form that is readily utilized by growing plants. The beneficial response of FYM and poultry manure to yield might also be attributed to the availability of sufficient amounts of plant nutrients throughout the growth period and especially at critical growth period of crop resulting in better uptake, plant vigour and superior yield attributes (Choudhary *et al*., 2003 and Mishra *et al.*, 1999) [7, 22]. The incorporation of FYM in the soil and it successive decomposition enabled the onion crop to ensure an almost continuous supply of macro and micronutrients distributed over the entire crop growth period. These results are agreement with findings corroborate with the results of several others (Prakash 2000, Narayanamma *et al.*, 2004, Blay *et al*., 2002, Chavan *et al*., 2016 and Dhaker *et al*., 2017) [26, 23, 4, 6, 10].

In case of biofertilizers, significantly higher neck thickness of bulb (1.21 cm), bulb diameter (5.41 cm), fresh weight of bulb (102.66 g) and bulb yield (184.81 q ha^{-1}) were recorded under inoculation with (B_{AP}) *Azospirillum* + PSB over rest of the treatments. *Azospirillum* noticed increased activity of plant growth substances like gibberellic acid, indole acetic acid and dihydrozeatin in inoculated plant which inturn improved the yield was observed by Subbian (1994) [30] and Prabhakar (2012) [25]. The significantly increased due to combined application of *Azospirillum* + PSB might due to increased in availabilty of nitrogen and phosphorus in yield attributes in onion. The increased availability of nitrogen due to *Azospirillum* coupled with phosphorus due to PSB might have increased the yield attributes and ultimately the yield. These findings corroborate the results of Mehta *et al*. (1995) [18], Meena *et al.* (2003) [17], Singh *et al*. (2008) [27], Singh *et al*. (2017) [17] and Vachan and Tripathi (2017) [34].

Table 1: Growth characters of *kharif* onion as influenced by organic manures and biofertilizers at harvest

Treatments	Crop growth characters		
	Plant height (cm)	Number of leaves $plant^{-1}$	Fresh weight (g) of leaves $plant^{-1}$
Organic manures			
T_0: Control	48.12	9.97	52.57
T_1: FYM 10 t ha^{-1}	51.89	10.95	56.10
T_2: Vermicompost 5 t ha^{-1}	55.10	11.70	57.79
T_3: Poultry manure 5 t ha^{-1}	58.24	12.44	59.84
T_4: FYM 5 t ha^{-1} +V.M. 2.5 t ha^{-1}	63.58	13.66	63.10
T_5: FYM 5 t ha^{-1} + P.M. 2.5 t ha^{-1}	61.83	13.34	61.18
SEm±	1.18	0.27	0.74
CD (P=0.05)	3.38	0.77	2.12
Biofertilizers			
B_0: Control	50.55	10.28	54.90
B_A: *Azospirillum*	56.94	12.26	59.13
B_{AP}: *Azospirillum* + PSB	61.91	13.41	61.26
SEm±	0.84	0.19	0.52
CD (P=0.05)	2.41	0.55	1.53

Table 2: Yield attributes and yield of *kharif* onion as influenced by organic manures and biofertilizers

Treatments	Yield attributes and yield			
	Neck thickness of bulb (cm)	Diameter of bulb (cm)	Fresh weight of bulb (g)	Bulb yield (q ha^{-1})
Organic manures				
T_0: Control	0.96	3.69	79.77	136.30
T_1: FYM 10 t ha^{-1}	1.07	4.21	88.43	155.83
T_2: Vermicompost 5 t ha^{-1}	1.08	4.56	92.51	160.61
T_3: Poultry manure 5 t ha^{-1}	1.18	5.05	101.32	179.61
T_4: FYM 5 t ha^{-1} +V.M. 2.5 t ha^{-1}	1.21	5.36	103.55	187.61
T_5: FYM 5 t ha^{-1} + P.M. 2.5 t ha^{-1}	1.27	5.53	109.67	199.50
SEm±	0.03	0.15	2.74	6.30
CD (P=0.05)	0.10	0.42	7.88	18.10
Biofertilizers				
B_0: Control	1.01	4.11	89.65	155.22
B_A: *Azospirillum*	1.13	4.69	95.35	169.70
B_{AP}: *Azospirillum* + PSB	1.21	5.41	102.66	184.81
SEm±	0.02	0.12	1.94	4.45
CD (P=0.05)	0.07	0.33	5.58	12.80

Conclusion

On the basis of one year experiment it may be concluded that application of FYM 5 t ha^{-1} + Poultry Manures 2.5 t ha^{-1} along with inoculation with *Azospirillum* + PSB recorded significantly higher values of growth, yield attributes and yield of *kharif* onion under the agro-climatic condition of Jaipur, Jaipur.

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