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Yield and Quality of Sand Mulched Onion with the Application of Different Liquid Organic Manures

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Abstract The present investigation had been conducted during the *rabi* season of year of 2012-13. Different liquid organic manures viz. *Shashyagavya* 20% (T_1), *Shashyagavya* 10% (T_2), *Sanjivani* 20% (T_3), *Sanjivani* 10% (T_4), Mustard oilcake solution 12.5% (T_5), Cow urine 10% (T_6) and only water (T_7) as control were used for the study. A sand layer of approximately 1.2 cm was applied as mulching medium over the experimental beds of all treatments. Onion cv Agrifound Dark Red was employed as planting material for the experiment by adopting CRBD with three replications. Results were found to be significant in most of the studied characters of both yield and quality parameters. Maximum values for bulb weight (93.23 g), bulb diameter (6.23 cm), plant height (66.73 cm), leaf number (11.93), neck diameter (1.18 cm), harvest index (86.0%), TSS (11.0 ^{0}Brix), ascorbic acid (11.32 mg/100 g), total sugar (7.19%) and reducing sugar (3.89%) were recorded in different organic liquid manures applied treatments except control.

Keywords Onion, *Allium cepa* L. Agrifound Dark Red, Organic liquid manures, Organic farming.

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Introduction

Onion, the queen of kitchenis a bulbous herb of Alliaceae family used world-wide in daily diet for its nutritional and medicinal value. Onion has been cultivated in India since last 5,000years. Probably there are very few countries where no onion is grown or eaten and it has good demand in foreign trade; hence, it is treated as a 'global product'. India is the second largest producer of onion just after China [1]. During 2013-14, onion was grown over an area of 4448 thousand hectare with a production of more than 85 million tonnes globally and it was 1,203 thousand ha and approximately 19 million tonnes for India [2]. Most of the farmers of our country come under small and marginal category and it is difficult for them to apply the recommended dose of inorganic fertilizers in onion cultivation as they are economically poor and vulnerable. In addition, many research work also reported that regular application of inorganic fertilizer hamper the soil structure and the organisms living within that.

Table 1. Details of treatments used for the experiment.

Treatments	Organic solution	Ingredients	Duration of fermentation (days)
T_1	*Shashyagavya* (20%)	Cow dung: cow urine:agricultural waste: water= 1:1:1:5	11
T_2	*Shashyagavya* (10%)	Cow dung: cow urine: agricultural waste: water= 1:1:!:10	11
T_3	*Sanjivani* (20%)	Cow dung:cow urine: water= 1:1:5	9
T_4	*Sanjivani* (10%)	Cow dung:cow urine: water= 1:1:10	8
T_5	Mustard oil cake solution (12.5%)	Mustard oil cake:water = 1:8	Overnight soaking
T_6	Cow urine 10%	Cow urine: water= 1:10	2
T_7	Normal water as control	Only water	2

The way to maintain long term soil fertility and increase the number of microorganisms is the organic farming. Organic agriculture is a production system that sustains the health of soils, ecosystems and people and it also reported the quality parameters especially reducing sugars in onion also improved with organic farming [3]. For most of the small and marginal Indian farmers, *Vedic Krishi t*echniques are suitable because these items are low input costs and comply well with the ecological and socio-economic conditions of vast segment of farming community [4]. Liquid solutions enhance nutrient availability for its water content and nutrient availability is homogeneous throughout the solutions. Some researchers [5—7] had made attempt to work on liquid organic fertilizer but their number is very less, hence the availability of scientific literatures are very few and liquid organic manures remains backward in scientific literatures from very begining, only some literatures are available on bio-dynamic agriculture. Though *Panchagavya, Jeevamrul, Beejamrut,* compost tea are popular in some of the part of India but only as growth promoter, not as source of nutrient [8, 9]. The benefits of using mulching materials are well known and hence progressive vegetables growers uses mulch (plastic mulch in most of the cases). Shallow root system are found in onion and its root development happen more in loose soil as compared to hard soil. Sand mulch was extensively used in areas with limited soil moisture to reduce evaporative water losses from soil surface and competitive weed growth. Rock and sand mulches have been used for centuries in the semi-arid areas of North-Western China [10]. In this backdrop, the present study attempts to find out the performance of sand mulched onion with the application of different liquid organic manures.

Materials and Methods

This investigation was carried out at the experimental farn of the faculty center Integrated Rural and Tribal Development and management under the School of Agriculture and Rural Development of Ramakrishna Mission Vivekananda University, Morabadi, Ranchi 834008, Jharkhand, India, in the year 2012-13. According to the geography of Ranchi, this city of Jharkhand is located at 23.23 ^{0}N latitude and 85.23 ^{0}E longitude.

Seven organic solutions (including one control) as treatments (Table 1) were tested in randomized block design with their three replications. Cow dung and cow urine were collected from a five year old milking Sahiwal cow of Divyayan Krishi Vigyan Kendra and other base materials for the preparation of liquid organic solutions were collected from same institute. Different chemical properties like pH, EC, Organic Carbon, available N, available P, and available K of these organic liquid solutions were also recoded. Agrifound Dark Red variety of onion was used as planting material. Sixty days old healthy seedlings were transplanted in flat beds as a spacing of 15 × 10 cm in a plot of 1.8 × 1.2 m during the 2nd week of December. FYM at the rate of 2.5 kg was applied in each plot at the time of bed preparation and organic solutions were applied on 20, 35, 50 and 65 DAT (Days after transplanting). Beds were mulched with a uniform sand (particle size 0.1 to 1.5 mm) layer of 1.2 cm. Intercultural operations like gap filling, weeding, irrigation were performed as and when needed. Ten plants from each replication were selected randomly to record the required observations on both quantitative and qualitative characters. The actual yield (kg plot^{-1}) was converted on t ha^{-1} for better understanding and the

Table 2. Nutritional status of all applied materials. These results may vary with place and time, depending upon the particular sitiation.

Treatment materials	pH	Electrical conductivity (mmhos cm^{-1})	Organic carbon (%)	Available nitrogen (%)	Available phosphorus (%)	Available potassium (%)
Cow dung	7.91	3.62	4.21	0.08	0.006	0.698
Cow urine	8.52	1.79	0.48	0.03	0.001	0.289
Shaspyagavya (20%)	5.50	2.20	0.34	0.04	0003	0.152
Shashyagavya (10%)	5.90	1.92	0.27	0.04	0.004	0.105
Sanjivani (20%)	7.30	4.10	0.31	0.04	0.004	0.087
Sanjivani (10%)	7.20	2.80	0.39	0.04	0.003	0.091
Mustard oil cake (12.5%)	4.71	2.60	3.10	0.05	0.013	

harvest index was determined by economic yield divided by total biomass yield.

Results and Discussion

Nutritional status of the liquid organic solutions varies one place to another and to fix this problem major nutrient analysis (Table 2) of these liquid solutions were made an integral part of this experiment.

The higher root length in T_7 (Table 3) may be due to absence of plant nutrients in sand medium, as well as for searching of nutrients to pursue their basic requirements; on the contrary, in T_6 treatment (where only 10% cow urine was applied) the lowest root length was observed because of proximate availability of nutrients especially nitrogen. It has been established that nitrogen helps to enhance shoot growth at the expense of root development in most vegetable [11] and hence the result. Nitrogen and phosphorus has great influence on formation of protoplasm, cell division, encouragement in cell elongation, meristematic activity as these accelerate synthesise of amino acid, cellular protein, chlorophyll, nucleic acid and thus these are the vital components for plant growth [12]. Better growth of onion in terms of growth parameters were basically due to higher availability of major plant nutrients and vice-versa their deficiencies hamper growth.

In the case of other growth parameters like bulb weight and bulb diameter were recorded higher in Sanjivani (10%) solution (Table 3). Such type of finding is obvious because, T_5 and T_6 treatments contained comparatively higher nutrients especially nitrogen and consequently used by the plant system for its vegetative growth, on the hand, T_7 that consists of only normal water that is almost scarce of any plant nutrient, hence the result. It is proven that potassium involved in carbohydrate and protein metabolism by increasing the enzyme activities which an important role during photosynthates translocation form leaves to bulb and there after the added potassium helps the plant for better vigor and increase in more no of leaves [13]. No significance difference was found among different treatments in the case of harvest index (Table 3). Such finding was obvious because economic yield is directly proportional to the biological yield of the crop. Nitrogen increases the utilization of carbon dioxide for photosyntheses and as a result, causes an increase in production of assimilates for plant growth [14]. Yield is considered as dependent variable, generally it is dependent on yield attributing characters. As higher magnitude of most of the yield attributing characters recorded for T_4, so highest yield of 54.75 t ha^{-1} were recorded for T_4, and lowest for control (27.33 t ha^{-1}).

Previous research work found [15] mentioned TSS content was increased on the clay by 1.2-fold as compared with the sandy loam. In this investigation sands were used as mulching material that caused a lower level of TSS than the TSS level recorded in another experiment [16]. Nitrogen from any kind of fertilizer affects the amount of vitamin C and nitrates as well as the quantity and quality of protein produced by plants. The synthesis of vitamin C is reduced when a plant is grown with lot of nitrogen as nitrogen increases protein production at the cost of

Table 3. *Per se* performance of different yield attributing characters of onion as recorded under divergent treatment conditions.**=Significant at 0.01 probability level, *=Significant at 0.05 probability level and NS= Non significant.

Treatments	Root length (cm)	Bulb weight (g)	Bulb diameter (cm)	Plant height (cm)	Leaf number plant	Neck diameter (cm)	Harvest index	Yield (t ha^{-1})
T_1	9.49	62.76	5.41	63.43	9.80	1.17	0.73	44.69
T_2	10.62	59.86	5.12	57.54	9.73	0.82	0.68	35.66
T_3	11.74	58.65	5.51	65.31	11.23	1.18	0.81	40.29
T_4	10.27	93.23	6.23	59.77	11.93	1.00	0.86	54.75
T_5	9.41	78.11	5.72	66.73	10.13	1.13	0.76	47.74
T_6	8.50	69.56	5.00	66.09	9.43	0.93	0.77	46.95
T_7	12.25	42.05	4.54	37.34	8.33	0.76	0.73	27.33
F value	3.25*	7.32**	27.25**	3.48*	7.26**	6.50**	NS	5.50**
SEm (±)	0.74	5.99	0.10	2.17	0.44	0.07	0.05	3.83
CD *p* 0.05	1.86	15.01	0.45	5.46	1.92	0.29	0.12	16.71
CV (%)	12.41	15.65	3.35	6.02	7.56	11.47	10.86	15.61

production of carbohydrate, which is an essential compound for vitamin C synthesis [17]. This type of observation may probably due to higher amount of available plant nutrient resources in T_1 (9.63 mg 100 g^{-1}) and T_6 (10.22 mg 100 g^{-1}) treatments as compared to T_2 (11.19 mg 100 g^{-1}) and T_4 (11.32 mg 100 g^{-1}) treatments. The variation of reducing sugars may be due to the utilization of reducing sugars, like glucose ande fructose for respiration after harvesting and thereby the level of these constituents decreased after harvest of onion from main field. (Table 4).

Conclusion

From the above findings, it may be concluded that the performance of yield as well as quality attributes of sand mulched onion were emerged as the best under the influence of Sanjivani 10% (T4). The effect of Sanjivani 10% solution in on farm trials also found comprehensive results and farmer can easily adopt this technique to get higher returns.

Table 4. *Per se* performance of different quality characters of onion as recorded under dissimilar treatment condition. **=Significant at 0.01 probability level, *=Significant at 0.05 probability level and NS=Non-significant.

Treatments	TSS (^{0}Brix)	Ascorbicacid (mg 100 g^{-1})	Total sugar (%)	Reducing sugar (%)
T_1	10.5	9.63	6.25	3.43
T_2	11.0	11.19	6.18	3.47
T_3	10.9	10.87	6.3	3.51
T_4	10.7	11.32	5.98	3.89
T_5	10.8	10.24	6.43	3.29
T_6	10.9	10.22	7.19	2.79
T_7	10.8	10.98	6.62	3.34
F value	NS	6.87**	3.56*	3.08*
SEm (±)	0.41	0.23	0.21	0.12
CD (at 5%)	1.06	0.59	0.52	0.30
CV (%)	6.71	3.83	5.62	6.03

References

1. Vanitha SM, Chaurasia SNS, Singh PM, Naik PS (2013) Vegetable statictics. Tech Bull No. IIVR, Varanasi, pp 250.
2. FAO (2015) World census of agriculture, FAOSTAT-2015, food and agriculture organization of the united Nations. Retrieved from http:www. fao.org.
3. Walia SS, Kler DS (2009) Organic versus chemical farming-A Review. J Res 46 : 114—126.
4. Chadha S, Rameshwar, Ashlesha, Saini JP, Paul YS (2012) Vedic krishi : Sustainable livelihood option for small and marginal farmers. Ind J Trad Knowl 11 : 480—486.
5. Govere S, Madziwa B, Mahlatini P (2011) The nutrient content of organic liquid fertilizers in Zimbabwe. Int J Modern Eng Res 1 : 196—202.
6. Lee J (2010) Effect of application methods of organic fertilizer on growth, soil chemical properties and micro bial densities in Organic bulb onion production. Scientia Horticulturae 24 : 299—305.
7. Martinez-Alcántara B, Martinez-Cuenca MR, Fernández C, Legaz Fand Quiñones A. (2016) Production of 15 N-Labelled liquid organic fertilizers based on manure and crop residue for use in Fertigation stñudies. PloS One 11 e0150851.
8. Palekar S (2006) Text book on Shoonya Bandovalada naisargika Krushi Swamy Anand, Agri Prakashana, Bangalore.
9. Vasanthkumar HHA (2006) Jeevamrut slurry preparation. Siri Samruddhi, pp 4—5.

10. Wittwer SH, Castilla N (1995) Protected cultivation of horticultural crops worldwide. Hort Technol 5 : 6—23.
11. Tremblay N, Yelle S, Gosselin A (1987) Effect of CO_2 enrichment, nitrogen and phosphorus fertilization on growth and yield of celery transplants. Hort Sci 24 : 875—876.
12. Abd El-Samad EH, Khalif RKhM, Lashine ZA, Shafeek MR (2011) Influence of urea fertilization and foliar application of some micronutrients on growth, yield and bulb quality of onion. Aust J Basic and Appl Sci 5 : 96—103.
13. Bagali AN, Patil HB, Chimmad VP, Patil PL, Patil RV (2012) Effect of inorganics and organics on growth and yield of onion (*Allium cepa* L.). Karnataka J Agric Sci 25 : 112—115.
14. Weerakoon MW, Olszyk DM, Moss DN (1999) Effects of nitrogen nutrition on responses of rice seedlings to carbon dioxide. Agric Ecosys & Environ 72 : 1—8.
15. Abbey L, Joyce DC, Aked J, Smith B, Marshall C (2004) Electronic nose evaluation of onion headspace volatiles and bulb quality as affected by nitrogen, sulfur and soil type. Annals of Appl Biol 145 : 41—50.
16. Khashti B, Rana DK (2012) Response of micronutrients on qualitative and quantitative parameters of onion (*Allium cepa* L.). Prog Hort 44 : 2249—5258.
17. Salunkhe DK, Desai BB (1988) Effects of agricultural practices, handling, processing, and storage on vegetables. In :Karmas E, Harris RS (eds). Nutritional evaluation of food processing AVI Publ Co, New York, pp 23—71.