E-ISSN: 2618-0618
P-ISSN: 2618-060X

www.agronomyjournals.com
2024; 7(1): 197-200
Received: 02-11-2023
Accepted: 11-12-2023

Saylee P Patil
M.Sc Scholar, Department of Agronomy, College of Agriculture, Dapoli, DBSKKV, Dapoli, Ratnagiri, Maharashtra, India

Dr. Viresh G Chavan
Assistant Professor, Department of Agronomy, College of Agriculture, Dapoli, DBSKKV, Dapoli, Ratnagiri, Maharashtra, India

Dr. Vaibhav A Rajemahadik
Assistant Professor, Department of Agronomy, College of Agriculture, Dapoli, DBSKKV, Dapoli, Ratnagiri, Maharashtra, India

Dr. Rajesh V Dhopavkar
Head, Department of Agronomy, College of Agriculture, Dapoli, DBSKKV, Dapoli, Ratnagiri, Maharashtra, India

Dr. Suchitra S Desai
Deputy Director of Research, DBSKV, Dapoli, Maharashtra, India

Bhakti S Patil
Senior Scientist, AICRP on Agroforestry, College of Forestry, DBSKKV, Dapoli, Ratnagiri, Maharashtra, India

Sanika P Patil
M.Sc scholar, Department of Agronomy, College of Agriculture, DBSKKV, Dapoli, Ratnagiri, Maharashtra, India

Corresponding Author:
Saylee P Patil
M.Sc Scholar, Department of Agronomy, College of Agriculture, Dapoli, DBSKKV, Dapoli, Ratnagiri, Maharashtra, India

Growth, yield and economics of white onion (*Allium cepa* L.) as influenced by different land designs and foliar application of bio-stimulants in Konkan region of India

Saylee P Patil, Dr. Viresh G Chavan, Dr. Vaibhav A Rajemahadik, Dr. Rajesh V Dhopavkar, Dr. Suchitra S Desai, Bhakti S Patil and Sanika P Patil

DOI: https://doi.org/10.33545/2618060X.2024.v7.i1c.210

Abstract
The field experiment was carried out during the *rabi* season (December- March) of 2022-23 at Agronomy farm, College of Agriculture, Dapoli, Maharashtra, to study the effect of different land configuration and foliar sprays of bio-stimulants on growth, yield and economics of white onion (*Allium cepa* L.). Experiment was replicated thrice in strip- plot design with 15 treatment combinations. Six week old seedlings of white onion cv. Alibaug local were transplanted, on three different land configurations (M), *viz.* flatbed (M_1), furrow irrigated raised bed (FIRB) (M_2) and ridges and furrow (M_3), transplanted at a distance of 30 x 15 cm distance and were sprayed with two different concentrations of bio-stimulants (B), *viz.* K-sap 0.5% (B_1) and 1.0% (B_2) and chitosan 0.5% (B_3) and 1.0% (B_4) along with water spray (B_5) as control treatment. Higher yield and net returns were obtained when white onion was transplanted on flatbed method and sprayed with chitosan 1.0% foliar spray or K-sap 1.0% spray at 30 and 55 DAT.

Keywords: White onion, land configuration, K-sap *(Kappaphycus alvarezii)*, chitosan, bio-stimulants, growth, yield, economics

Introduction
Onion (*Allium cepa* L.), also known as piyaz in Hindi, kanda in Marathi, and Palandu in Sanskrit, is the most widely cultivated member of the Allium genus and has been grown for food, medicine, and religious uses since ancient times. It is one of the most important monocotyledonous crops, belonging to the genus Allium, which has about 750 species. The most important edible *Allium* crop includes onion, Japanese bunching onion, leeks, chive, and garlic. The alleged ancestor of the onion, originated in Central Asia, were probably carried to the Near East. Subsequently, it extended to South-East Asia and India, the Mediterranean area, and ultimately to the Roman Empire as a whole (Grubben and Denton, 2004) [9]. It is a cross-pollinated, cool-season vegetable crop that is used in every kitchen. It is in high demand all year round and gives vegetable growers a reliable source of income. Onion bulbs are pungent because they contain allyl-propyl disulfide, a volatile oil (Baloch, 1994) [4]. The mature bulbs comprise some starch, some sugar, some protein and vitamins A, B and C (Jilani *et al.*, 2010) [10]. According to "Charak Samhita" (Ray and Gupta 1980) [19], onions have been used medicinally since the third or fourth century. They are a potential herb since they contain chemicals such sulphites, ajoene, thiosulfinates, and allicin. Frequent intake of these nutrients supports the fight against rheumatism, liver diseases, high blood sugar, high cholesterol, and cancer.
After the potato and tomato, onions are ranked as the third most valuable vegetable in the world. India ranks fourth in global onion export, with a total export of 14.49 lakh tons of onion in 2020-21, worth 346.64 million USD (FAOSTAT 2020-21) [1]. In India, onions are grown during the three seasons of *kharif*, late *kharif* and *rabi* in an array of meteorological conditions. According to Lawande and Murkute (2011) [12] and Murkute (2012) [13] the main crop is produced in *rabi* (60 per cent) and 20 per cent each is in late *kharif* and *kharif*. Over 16.24 lakh hectares area was covered under onion crop in 2020-21, yielding a total of 266.41 lakh tons (NHRDF 2021) [2].

The principal states for onion production are Maharashtra (45.48 Lakh tonnes), Madhya Pradesh (26.60 Lakh tonnes), Gujarat (16.57 Lakh tonnes), Rajasthan (13.86 Lakh tonnes), Bihar (13.28 Lakh tonnes), West Bengal (7.47 Lakh tonnes), and Andhra Pradesh (6.36 Lakh tonnes) (NHRDF 2021) [2]. Even though onion is cultivated in varied amounts across the country, Maharashtra leads in terms of output (45.48 Lakh tonnes) and plays a major role in price determination and distribution throughout the nation. Apart from domestic consumption, Maharashtra accounts for the majority of exports. Maharashtra accounts for 43.27 per cent of the country's land area and 39.32 per cent of its production (NHRDF 2021) [2].

For easy and consistent germination as well as plant growth and development, the land design is very crucial. Konkan soils exhibit variable crop productivity based on a variety of physical, chemical and microbiological characteristics of soil, including the parameters related to mineralogy (Bhattacharyya *et al*. 2013; Pal and Deshpande 1987; Patil 2016) [5, 14, 16]. As the rainfall and soil characteristics play a major role in crop growth and productivity, it is essential to study the effect of land configuration on growth and development of different crop varieties. Thus, it is crucial to investigate the benefits of improved land configuration techniques like furrow irrigated raised bed method, ridges and furrow method and along with that, traditional flatbed method to compare the differences and find out the conclusion. Also the invariable use of chemical fertilizers on crops to obtain maximum benefit, threatens human health while negatively affecting the ecosystem. Use of environment friendly amendments for crops to obtain good yield can be a solution to this ever rising problem of pollution. Bio-stimulants being environment friendly can be used as a substitute for inorganic fertilizers. While considering the aforementioned facts regarding the importance of use of proper land design for growing crops and awareness regarding the incorporation of bio-stimulants in farming system, the current study was conducted to determine the effect of different land configurations and foliar spray of bio-stimulants on growth, yield and economics of white onion in Konkan region of Maharashtra.

Materials and Methods

The experiment was conducted at Instructional farm of Agronomy department, College of Agriculture, Dapoli which falls under subtropical region at an latitude 17º45'55" N, longitude 73º10'29" E, and at an altitude of 250 meters above mean sea level, during *rabi* 2022-23. A total of 2.8 mm rainfall and 32.7- 14.7 ºC temperature was recorded during the agriculture growing season of year 2022-23. The soil in the experimental field had a sandy clay loam texture, a slightly acidic pH (5.57), moderate electrical conductivity (0.23 $dSm^{-1)}$, with high organic carbon content (14.31 g kg^{-1}) and moderate levels of accessible nitrogen (290.11 kg ha^{-1}), phosphorous (9.8 kg ha^{-1}) and potassium (298.15 kg ha^{-1}). The experiment was laid out in strip plot design with three land configuration techniques *viz*., flatbed, furrow irrigated raised bed and ridges and furrow system and five foliar spray of different concentrations of bio-stimulants *viz*., K-sap 0.5%, K-sap 1.0%, chitosan 0.5% and chitosan 1.0% and a control treatment plot of water spray.

The experiment was replicated thrice, with gross plot size of 4.50 m x 3.60 m and net plot size of 4.20 m x 3.00 m respectively. White onion cv. Alibaug local was used for experimental research which was transplanted at a distance of 30 cm x 15 cm distance. The prescribed dosage of fertilizers (100:50:50 kg N: P: K kg ha^{-1}) was administered as basal dose of N, P and K at time of sowing, followed by two split doses of nitrogen at 30 DAT and 60 DAT, using urea, single super phosphate and muriate of potash. A uniform distribution and incorporation of well rotten FYM (1500 Kg) was made into the soil at the time of bed preparation by broadcasting. The foliar spray of each bio-stimulant and water spray treatment was applied twice during the experiment, first at 30 DAT and second at 55 DAT, according to the decided treatment protocol.

Irrigation was provided through flood irrigation at seven days interval each after transplanting of crop, and initially immediately after transplanting of crop for proper crop stand and survival. Gap filling was carried out eight days after transplanting of seedlings, in order to maintain proper plant population. Tebuconazole 50%+ Trifloxystrobin 25% w/w 75 WG @ 200 gm a.i. ha^{-1} and Propiconazole 25% EC @ 500 ml a.i. ha^{-1} were used as a measure of plant protection aid against fungal diseases. Also, Quizalofop- ethyl 4% + Oxyflurofen 6% @ 988 ml a.i. ha^{-1} was used as a post emergence herbicide and Oxyflourfen 23.5% EC @ 150 ml a.i. ha^{-1} (hook leaf stage) was used as a pre emergence herbicide to get rid of weeds in the field. Harvesting of crop was done at 120 days after transplanting by uprooting the bulbs. The data pertaining to each character was analysed using the analysis of variance approach as applicable in strip plot design, and the significance of the treatment difference was tested by variance ratio test (f value), critical difference (C.D.) at 5 per cent level of probability was worked out for comparison and statistical interpretation of significance between treatments mean as described by Panse and Sukhatme (1967) [15].

Results and Discussions

Effect on growth

The combined effects of bio-stimulant foliar spraying and land design strategies had a substantial impact on white onion development (Table 1). The transplanting of the white onion crop using the flatbed method was the treatment that produced the best results in terms of plant height (15.25, 43.81, 50.69, and 53.61 cm) and number of leaves per plant (4.03, 7.39, 8.24, and 8.87) at 40, 60 DAT and at harvest. The results achieved were similar to transplanting on raised beds with furrow irrigation in terms of plant height and leaf count per plant. Plant height and leaf count were lowest on ridges and furrows method of transplanting. But neither the height of the plants nor the quantity of leaves on each plant reached a statistically significant level at 20 DAT. The outcome can be explained by the fact that the larger root surface area promoted efficient plant nutrient uptake, which enhanced crop growth and development; better soil physical conditions; and sufficient, even air and water flow promoted root aeration, allowing roots to grow deeply and uniformly throughout the planting area, accessing nutrients and water spaces while lowering the risk of water logging, all of which aided in the quick development of crops. The physical structure of the soil was conducive to the correct growth of the crop in terms of plant height and leaf count per plant. In the context of the crop, the current study's findings are in close agreement with those of Singh *et al*. (2003) [20], Dodake (2005) [7], and Ardeshna (2011) [3].

Table 1: Effect of land configurations and foliar spray of bio-stimulants on growth of white onion as influenced by different treatments

Treatments	Plant height (cm)				Number of leaves per plant			
	20 DAT	40 DAT	60 DAT	At harvest	20 DAT	40 DAT	60 DAT	At harvest
Vertical strip (Land configuration) (M)								
M_1: Flat bed	15.25	43.81	50.69	53.61	4.03	7.93	8.24	8.87
M_2: Furrow irrigated raised bed	15.17	43.35	49.05	51.95	3.77	7.20	7.52	8.18
M_3: Ridges and furrows	15.07	41.01	46.84	49.77	3.87	6.65	6.99	7.82
S.Em. ±	0.02	0.38	0.49	0.49	0.03	0.165	0.16	0.14
C.D. at 5%	NS	1.52	1.96	1.95	NS	0.65	0.69	0.53
Horizontal strip (Bio-stimulants) (B)								
B_1: K-sap 0.5%	14.91	42.35	48.52	51.94	3.87	6.60	7.04	7.78
B_2: K-sap 1.0%	15.17	44.25	50.23	53.00	4.00	7.83	8.09	8.87
B_3: Chitosan 0.5%	15.26	42.44	48.30	51.15	3.76	7.17	7.44	8.13
B_4: Chitosan 1.0%	15.32	46.85	53.92	56.62	3.98	8.37	8.61	9.18
B_5: Water spray	15.17	37.71	43.32	46.14	3.84	6.33	6.72	7.49
S.Em. ±	0.05	1.11	1.28	1.26	0.03	0.28	0.26	0.24
C.D. at 5%	NS	3.63	4.16	4.11	NS	0.92	0.84	0.78

Effect on yield

Land configuration and foliar spraying of bio-stimulants had significant influence on yield of white onion. Highest fresh bulb yield (t ha^{-1}) (15.68) and after curing bulb yield (t ha-1) (11.53) was obtained from flatbed method of land configuration, which was followed by the results of furrow irrigated raised bed system i.e. (14.69) and (10.80) respectively. Foliar application of chitosan 1.0% produced the highest yield i.e. (17.95) and (13.22) which was found to have similar resemblance to the foliar spray of K-sap 1.0% spray (16.07) and (11.79). According to Geries (2020) [8], chitosan's ability to increase stomatal conductance, net photosynthetic carbon dioxide (CO2) fixation activity, and leaf resistance to water vapour loss improved plant water use and increased biomass and yield. It also increased bulb weight and marketable yield per fed of onions. According to Tantawy (2021) [21], chitosan improves the crop's qualitative and quantitative qualities because it helps the plants absorb nutrients more effectively. According to Pramanik *et al.* (2017) [18], applying K-sap foliarly to potato crops stimulated the crop's growth and development. This may be because K-sap is a rich source of several primary and secondary nutrients as well as specific plant growth regulators, which in turn led to improved bulb development and increased plant growth. These results are consistent with Prajapati's (2016) [17] findings from his study on potatoes. In their study on onion crops, Found that increased leaf count, plant height, and bulb weight are the primary causes of yield increases. This is because the nutrients in the seaweed extracts are easily absorbed by the leaves through stomata and cuticle hydrophilic pores.

Table 2: Effect of land configurations and foliar spray of bio-stimulants on after harvest fresh bulb yield (t ha^{-1}) and post curing bulb yield (t ha^{-1}) of white onion as influenced by different treatments

Treatments	Fresh bulb yield (t ha^{-1})	After curing bulb yield (t ha^{-1})
Vertical strip (Land configuration) (M)		
M_1: Flat bed	15.68	11.53
M_2: Furrow irrigated raised bed	14.69	10.80
M_3: Ridges and furrows	11.21	8.36
S.Em. ±	0.61	0.43
C.D. at 5%	2.38	1.68
Horizontal strip (Bio-stimulants) (B)		
B_1: K-sap 0.5%	12.27	9.11
B_2: K-sap 1.0%	16.07	11.79
B_3: Chitosan 0.5%	13.32	9.82
B_4: Chitosan 1.0%	17.95	13.22
B_5: Water spray	9.68	7.21
S.Em. ±	1.08	0.78
C.D. at 5%	3.52	2.54

Effect on economics

Flatbed land configuration technique recorded higher cost of cultivation and net returns (Table 3) compared to the other two land configuration techniques. Also the highest B: C ratio was obtained from flatbed land (2.07) configuration technique which was followed by FIRB's (1.96). Foliar application of chitosan 1.0% helped obtain highest B: C ratio followed by K-sap 1.0%. Also the cost of cultivation and net returns obtained from these treatments were the highest.

Table 3: Effect of land configurations and foliar spray of bio-stimulants on economics of white onion as influenced by different treatments

Treatments	Input cost (₹ ha^{-1})	Cost of cultivation (₹ ha^{-1})	Gross returns (₹ ha^{-1})	Net returns (Input) (₹ ha^{-1})	Net returns (Total) (₹ ha^{-1})	B: C ratio (Input)	B: C ratio (Total)
Vertical strip (Land configuration) (M)							
M_1: Flat bed	208623.82	360063.59	750029.42	541405.60	389965.84	3.59	2.07
M_2: Furrow irrigated raised bed	211571.88	355372.40	702071.39	490499.51	346698.99	3.32	1.96
M_3: Ridges and furrows	215223.82	333047.61	543581.58	328357.76	210533.97	2.52	1.61

Horizontal strip (Bio-stimulants) (B)							
B_1: K-sap 0.5%	212166.32	337810.11	592703.00	380536.67	254892.88	2.80	1.74
B_2: K-sap 1.0%	211079.75	365550.16	766445.04	555365.29	400894.88	3.64	2.09
B_3: Chitosan 0.5%	211928.82	345224.11	638782.96	426854.13	293558.85	3.02	1.84
B_4: Chitosan 1.0%	212191.32	382319.07	859588.70	647397.38	477269.64	4.06	2.24
B_5: Water spray	211666.32	316569.22	468617.63	256951.30	152048.41	2.22	1.47
General mean	211806.51	349494.53	665227.46	453420.96	315732.93	3.15	1.88

Conclusion

Based on the results of the experiment, it was concluded that white onion cv. Alibaug local performs better when transplanted on flatbed method and sprayed with 1.0% chitosan or 1.0% K-sap at 30 and 55 days after planting. The flatbed transplanting method with foliar spraying of 1.0% chitosan or 1.0% K-sap will yield the highest B: C ratio.

References

1. Anonymous. Food and Agriculture Organization of the United Nations. FAOSTAT. [Internet]; c2021. Available from: www.faostat.org
2. Anonymous. The National Horticultural Research and Development Foundation. NHRDF. [Internet]; c2021. Available from: www.nhrdf.org
3. Ardeshna RB. Effect of land configuration and soil conditioners on growth and yield of Turmeric (*Curcuma longa* L.). Thesis submitted for Ph.D. (Agri.) degree to Navinchandra Mafatlal College of Agriculture, Navsari, Gujarat; 2011.
4. Baloch AF. Vegetable crops. Horticulture. National Book Foundation, Islamabad, Pakistan; c1994. p. 489-537.
5. Bhattacharyya T, Pal DK, Mandal C, Chandran P, Ray SK, Sarkar D, *et al*. Soils of India: Historical perspective, classification and recent advances in knowledge; A review. Curr. Sci. 2013;104:1308-1323.
6. Corzo-Martínez M, Corzo N, Villamiel M. Biological properties of onions and garlic. Trends Food Sci. Technol. 2007;18(12):609-625.
7. Dodake SB. Management of clay soils of South Gujarat for improving yield and quality of Onion. Thesis submitted for Ph.D. (Agri.) degree to Navinchandra Mafatlal College of Agriculture, Navsari, Gujarat; c2005.
8. Geries LSM, Hashem OSM, Marey RA. Soaking and foliar application with Chitosan and Nano Chitosan to enhancing growth, productivity and quality of Onion crop. Plant Arch. 2020;20(2):3584-3591.
9. Grubben JH, Denton DA. Plant Resources of Tropical Africa. PROTA Foundation, Wageningen; Backhuys, Leiden, CTA, Netherlands; c2004.
10. Jilani MS, Ahmed P, Waseem K, Kiran M. Effect of plant spacing on growth and yield of two varieties of onion (*Allium cepa* L.). Pak. J. Sci. 2010;62(1):37-41.
11. Krishnaswamy K. Traditional Indian spices and their health significance. Asia Pac. J Clin. Nutr. 2008;17(S1):265-268.
12. Lawande KE, Murkute AA. Initiatives in onion and garlic cool chain management. Proceedings of National Symposium on Postharvest Packaging, Cold-chain Logistics and Instrumentation Techniques for Quality and Safety of Perishables. Central Institute of Post-Harvest Engineering and Technology, Ludhiana, India; c2011. p. 183.
13. Murkute AA. Evaluation of onion varieties in ambient storage. DOGR News. 2012;16:2-3.
14. Pal DK, Deshpande SB. Characteristics and genesis of minerals in some benchmark Vertisols of India. Pedologie (Ghent). 1987;37:259-275.
15. Panse VG, Sukhatme PV. Statistical methods for agricultural workers, I.C.A.R. New Delhi; c1967.
16. Patil KD. Micronutrient Research in Konkan Region DBSKKV, Khar Land Research Station, Panvel, Maharashtra; c2016. p. 49.
17. Prajapati A, Patel CK, Singh N, Jain SK, Chongtham SK, Maheshwari MN, Patel CR, Patel RN. Evaluation of Seaweed Extract on Growth and Yield of Potato. Environ. Ecol. 2016;34(2):605-608.
18. Pramanick B, Brahmachari K, Mahapatra BS, Ghosh A, Ghosh D, Kar S. Growth, yield and quality improvement of potato tubers through the application of seaweed sap derived from the marine alga Kappaphycus alvarezii. J Appl. Phycol. 2017;29:3253-3260.
19. Ray P, Gupta HN. "Charaka Samhita" Scientific synopsis. Indian National Science Academy, New Delhi; c1980.
20. Singh A, Singh B, Singh A, Singh P. Response of ginger (*Zingiber officinale*) to methods of planting and levels of phosphorus in a rehabilitated forest developed on sodic land. J Spices. Aromat. Crops. 2003;12(1):63-66.
21. Tantawy IAA, Soltan HAH, Asmaa, Ezzat S. Efficiency of foliar application by chitosan and royal jelly on growth, yield and quality of two garlic cultivars. Int. J Agric. Sci. 2021;3(4):119-131.