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SHORT COMMUNICATION

Bedding System: A Unique Plantation Method of Pomegranate in Arid and Semi-arid Region

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Abstract Pomegranate has emerged as a cash crop in the arid and semi-arid region in recent years. However, paucity of proper planting system posed various management problems leading to lethal increase of plant diseases and significant reduction in yield. In the present study, a unique planting method i.e. bedding system was evaluated against traditional planting methods. Results revealed that bedding system of plantation (0.60 m width × 0.30 m deep trenches below the soil surface, above ground 2 m wide bed 45 cm high at the middle and sloping down towards both ends, separated by parallel dead furrows oriented in the direction of land slope) led to appropriate aeration in active root zone, avoiding water logging and increased nutrient uptake. These conditions facilitated the reduction in disease infestation and increased physical attributes significantly. All these favorable outputs culminated into significantly higher yield of pomegranate on the bedding system of plantation.

Keywords Pomegranate · Planting methods · Nutrient uptake · Diseases · Yield

Worldwide, 6150 million ha of land is under the influence of dryland agriculture which stretches over 48 countries of four continents. Introduction of efficient water-use and hardy horticultural crops like pomegranate (*Punica granatum* L.) have proved to be beneficial for cultivation on these lands. During last few decades, area under pomegranate plantation in India has increased to a great extent (106.6 thousand ha) due to its economic importance as a cash crop and its antioxidants and nutraceutical values [1]. It is being planted on different kinds of lands without considering its suitability [2], which has increased several management problems especially disease infestation such as wilt and bacterial blight [3]. Therefore, it is necessary to find out a suitable method of plantation for pomegranate for these arid and semi-arid regions. Hence, the present investigation was undertaken to find out performance of pomegranate grown on different planting systems.

Experiments were conducted at National Research Centre on Pomegranate, Solapur, Maharashtra, India. Soils of the experimental fields were categorized as Entisols (Lithic Ustorthants). Soil depth was hardly 8–10 cm underlined by weathered rock and soil contained very high contents of coarse fragments (54.6%) and loamy sand texture. Pits and trenches were dug and filled with loamy texture soil (sand 51.2%, silt 21.2% and clay 27.6%) forming different planting systems. The different planting systems formed in the field were pits of 1 m length × 1 m width × 1 m depth size (T_1), pits of 0.60 m length × 0.60 m width × 0.60 m depth size (T_2), continuous trenches of 1 m width × 1 m depth size (T_3), continuous trenches of 0.60 width × 0.60 m depth size (T_4), trapezoidal shape trenches 0.60 m depth, 1.5 m top width (T_5), bedding system (Fig. 1) i.e. 0.60 m width × 0.30 m deep trenches below the soil surface, above ground 2 m wide bed 45 cm high at the middle and sloping down towards both ends, separated by parallel dead furrows oriented in the direction of land slope. The water drains from the beds into dead furrows, which discharge into a field drain constructed at the lower end of the field and

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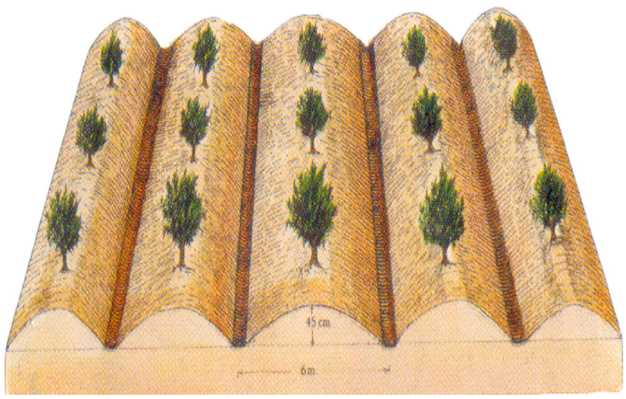

Fig. 1 Bedding system of plantation

perpendicular to the dead furrows (T_6) and bedding system as earlier except 0.60 m width × 0.60 m deep trenches (T_7). The experiment was laid out in randomized block design comprising of seven treatments with four replications having two plants per replication. Pomegranate cv. Bhagwa seedlings were planted on these planting systems during October 2007 adopting uniform management practices.

Growth parameters, disease infestation and its severity and yield in different planting systems were recorded three times during 2012–2013 and cumulated. About 70–75 days old leaves (recently matured) located at 8th pair on young shoot were sampled during April 2012 [4]. Each sample composed of 50 leaves, was washed thoroughly in sequence with water, liquid soap, acidic water and glass redistilled water and dried in shade for 4 days followed by oven drying at 70 °C till constant weight was attained. Ground leaf samples were digested in di-acid mixture [5] and analyzed for total nitrogen by micro-Kjeldahl steam distillation method; phosphorus by Vanadomolybdo phosphoric acid method; potassium by flame photometry; Ca and Mg by titrimetric method employing disodium salt of EDTA and micronutrients; Fe, Zn, Mn and Cu using atomic absorption spectrophotometer (Perkin Elmer, USA make Analyst 400).

Plant growth (Table 1) in terms of plant height and plant spread showed significant variation amongst the treatments. Vegetative growth of the plants grown under both sizes of bedding system i.e. T_6 and T_7 was significantly higher as compared to other treatments. Drastic reduction in growth of the plant was observed in other treatments, especially in continuous trenches treatments, which recorded lowest plant height (T_1) and plant spread (T_3). In citrus fruit crops, detrimental effect on vegetative growth, plant mortality was reported due to waterlogging conditions in the rootzone of the plants [6].

Wilt is one of the widespread and destructive diseases of pomegranate. Under continuous trench system of plantation, incidence of wilt disease was very high (100%) resulting into considerable mortality (50%) of the plants (Table 1). The wilt causing pathogens are soil inhabitants and survive in plant debris. Though disease pathogens are present in soil, it increases under favorable conditions like, frequent rains during rainy season, poor drainage and presence of high moisture content especially in active root zone or fibrous roots area [7]. In continuous trench system of cultivation, the disease spread was mainly because of these reasons. Most of the plants grown under bedding system of plantation remained healthy (75–87.5%) even after severe incidence of disease in the experimental plot. In bedding system, disease spread restricted mainly due to maintenance of well drained condition at least in surface soil zone having majority of fibrous roots activity.

The fruit yield in terms of number and weight revealed highly significant variation amongst the treatments (Table 1). Highest yield in terms of number and weight of fruits were produced under bedding system of plantation i.e. T_6 and T_7 which was significantly higher than other systems. It was mainly due to better nutrient availability in the soil, their uptake by the plants, and higher vegetative growth bearing higher number of fruits and less disease incidence. Weight of the fruit was also significantly high under bedding system of plantation. Drastic reduction in fruit yield in continuous trench system of plantation was mainly due to disease infestation on plants during bearing years. Quality of fruits was also much better under bedding system of cultivation. In other systems, due to disease incidence, the plants became chlorotic and fruits on such plants or branches becomes hard, non-juicy and had thick peel resulting in deterioration of fruit quality.

Plants grown under different planting system treatments significantly affected pattern of N and K macronutrient uptake (Fig. 2). The highest N (2.46%) and K (1.05%) concentration was observed in the leaves of the plants grown under bedding system of plantation. This was mainly due to better drainage conditions prevailing under this system of plantation. Presence of excessive moisture beyond field capacity soil moisture content inhibits the nitrification process [8]. Decreasing N uptake with higher moisture content or increasing water table was observed in case of citrus fruit crops [9, 10]. Leaf P, Ca and Mg was not influenced by different planting treatments. The soils of the semiarid regions were rich in Ca and Mg and resulted in less influence on their uptake by the plants. Amongst micronutrients, Fe concentration varied from 91.7 to 122.2 ppm and was highest in the plants grown on bedding system of plantation while Mn in trapezoidal trenches treatment which was at par with continuous trenches treatments. Highest content of Zn was also found in the plants grown under continuous trench treatment. Mn (52.3–62.4 ppm) and Zn (25.7–32.5 ppm) also showed a wide variation amongst treatments. The Cu concentration

Table 1 Vegetative growth, yield and disease infestation on the plants grown under different plantation systems

Treatments	Plant height (cm)	Plant spread (cm)	Fruit yield/plant		Average fruit weight (g)	Wilt disease infestation (% plants)			
			No. of fruits	Fruit weight (kg)		Disease incidence	Healthy plants	Severely infected live plants	Plant mortality
T_1	116.4	96.1	18.13	4.310	241.3	75.0	25.0	50.0	25.0
T_2	132.5	121.9	16.38	3.885	237.5	87.5	12.5	62.5	25.0
T_3	131.3	78.8	16.25	3.698	228.8	100.0	0.0	50.0	50.0
T_4	116.9	115.0	29.88	7.509	250.2	62.5	37.5	50.0	12.5
T_5	136.3	108.1	24.25	6.261	252.0	87.5	37.5	50.0	37.5
T_6	153.8	151.3	30.88	8.936	290.4	12.5	87.5	0.0	12.5
T_7	165.6	168.4	36.38	9.373	257.5	25.0	75.0	0.0	25.0
CD ($p < 0.05$)	12.2	43.6	9.27*	2.54*	24.0*	35.6*	35.6	41.1	–

* Significant at 0.01

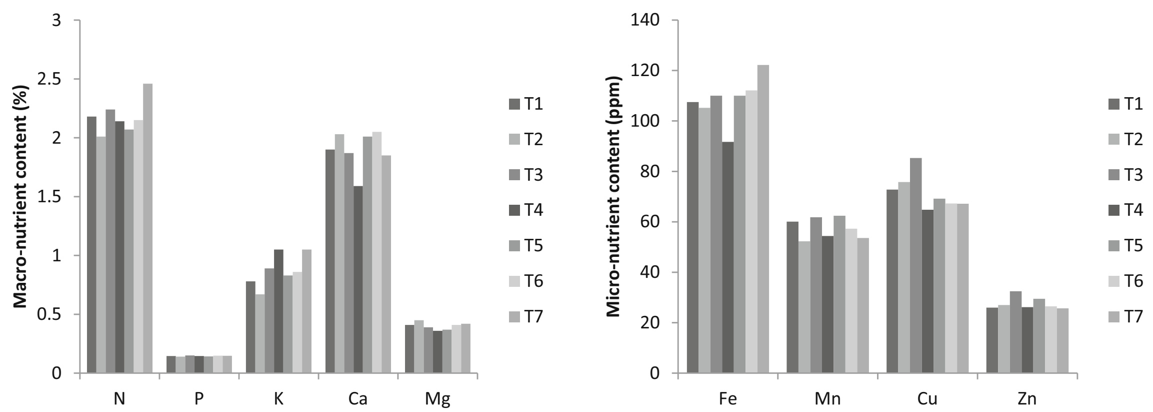

Fig. 2 Nutrient content in the leaves of pomegranate plants grown under different treatments. CD ($p < 0.05$): N (0.23), P (NS), K (0.21*), Ca (NS), Mg (NS), Fe (16.5), Mn (7.5), Cu (NS), Zn (4.5). * Significant at 0.01

in the leaf showed wide but non-significant variation which might be due to several copper based fungicidal spray used as part of regular prophylactic schedule for control of fungal diseases.

Therefore, from the present investigation it may be concluded that the bedding system of plantation is highly effective for reduction in plant diseases, increasing nutrient uptake, vegetative growth, fruit yield and reaping the highest profit out of pomegranate.

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