AN ANALYSIS OF KINNOW FARMING IN SIRSA DISTRICT OF HARYANA

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ABSTRACT

Introduction: *Growing fruit may be a demanding and rewarding pastime, as well as a pleasant and pleasurable experience. There are several compelling arguments in favour of cultivating fruit trees.*

Aim of the study: *the main aim of the study is to An Analysis of Kinnow Farming in Sirsa District of Haryana*

Material and method: *Before and after the experiment, the girth of the trunks of the experimental plants were measured at 15 centimetres above ground. The girth of the tree trunk was determined by using a measuring tape and was recorded in millimetres (cms).*

Conclusion: *The application of RDF + VC + Azospirillum + Trichoderma resulted in the greatest increase in trunk girth (4.28 cm) throughout the course of the two years taken together (T12).*

1. INTRODUCTION

1.1 OVERVIEW

The production of citrus fruits on a massive scale in tropical and subtropical environments is illustrative of their significance to the economy of the whole globe. Citrus has a significant influence on the socioeconomic system as well as the cultural landscape of the whole society. This fruit's indispensability in several regions of the globe is due to the myriad of nutritional and therapeutic benefits it provides. Citrus is appreciated most for its fruit, which may be consumed on its own as fresh fruit, made into juice, or combined with other ingredients to create new cuisines and drinks. At the present, there are 52,836 hectares dedicated to the cultivation of citrus in Punjab, and the province's yearly output is 10,49,977 tonnes. The production of kinnow mandarins takes up an area of 10,21,719 tonnes per year and covers a total of 49,356 hectares. The agroecological conditions of Punjab are ideal for the cultivation of Kinnow mandarin, making it the ideal location for this crop. The cultivation of kinnows has been a blessing for farmers owing to the better economic productivity of kinnows in comparison to the productivity of other fruit crops. Because this tropical fruit, the Kinnow, gained its resistance to abiotic stress from its mother parent, the King mandarin, it is also suited for consumption in the subtropical zone. The cultivation of Kinnow in Punjab serves as a shining example for the expansion of the citrus sector in that province. In addition, farmers in Punjab are known for their ingenuity; they have adopted high-density planting in order to increase their revenue in a shorter amount of time.

1.2 KINNOW

1.2.1 Soil And Climate

To guarantee the highest possible level of production, significant deliberation must be given to the choice of both location and site. In addition, the construction of an orchard is a kind of investment with a long time horizon, which calls for a great deal of meticulous preparation.

1.2.2 Varieties

Mandarin oranges, sweet oranges, grapefruits, limes, and lemons are the primary citrus fruits that are cultivated in Punjab. Oranges are in second place behind mandarins in terms of their economic importance. The significance of grapefruits, limes, and lemons is quite low.

1.3 PRE-HARVEST MANAGEMENT OF KINNOW

1.3.1 Major Commercial Varieties Grown

In Rajasthan Oranges that are suggested for commercial use include Nagpur santra, Kinnow, Khasi Orange, and Coorg santra. These are the most popular types. The farmers and merchants of Rajasthan are particularly well-known for giving Nagpur santra and Kinnow their attention. The Jhalawar district in Rajasthan is the primary location for the cultivation of mandarin.

2. LITERATURE REVIEW

Kumar, Rakesh & Bakshi, Parshant & Kumar (2022) In order to improve its cultivation and fruit availability for people living in rural regions, the performance of the Kinnow mandarin scion was evaluated on eight different rootstocks while growing in the rainfed conditions of the Jammu subtropics in the Indian state of Jammu and Kashmir (UT). During the course of the investigation, it was discovered that the Kinnow mandarin scion achieved the maximum plant height (275 centimetres), the maximum number of fruits (196.00), the maximum total yield (27.44 kilogrammes per plant), the maximum total sucrose content (11.33 degrees Brix), the maximum total sugar (7.95 percent), the maximum reducing sugar (5.66%), the maximum non-reducing sugar (2.29%), the maximum ascorbic acid (25.25 milligrammes per one hundred Rangpur lime rootstock was found to have the thickest peels with a weight of 53.33g and a thickness of 2.40mm respectively. It was discovered that both Jattikhatti and Gargal have the potential to be regarded as the finest rootstock in the Jammu area in order to expand the output of Kinnow and produce fruits of a higher grade.

Subedi, Giri & Atreya, Padma & Gurung (2020) Apples, citrus fruits, mangoes, bananas, guavas, and papayas are among the most important crops to be planted in Nepal's many agro ecological zones. Since the beginning of the previous twenty years, there has not been much of a change in the yield of fruit crops. The planting of orchards on marginal areas that are not irrigated, coupled with neglectful management methods and the use of conventional farming techniques, has led to poor yield. The notion of high density planting has gained traction in recent years due to a number of factors, including the ongoing reduction in the amount of land that is available for cultivation, the effect of climate change, the growing cost of both energy and land, and rising consumer demand (HDP). One of the most modern and innovative approaches of boosting the output of both annual and perennial fruit crops is called high density planting (HDP). When there is a healthy balance between vegetative development and fruiting in an orchard, a high yield may be attained along with improved fruit quality. This is made possible by having a balanced light distribution across the tree canopy. The fundamental idea is to optimise the utilisation of vertical and horizontal space in terms of both time and area, with the goal of achieving the highest possible return on investment for each component of the inputs and resources used. When it comes to figuring out how much fruit an orchard will produce, one of the most significant elements to consider is the planting density. The findings of the research indicated that the production of fruits may be increased if the HDP procedures were correctly implemented. The use of dwarf scion types, dwarfing rootstocks and inter-stocks, effective training and pruning, the application of plant growth regulators, and the implementation of appropriate crop management methods are the fundamental components of HDP. A successful outcome cannot be attained unless the manufacturing of goods for sale is integrated with the market. The country is in desperate need of a comprehensive strategy that includes a packhouse and a cold-chain facility.

Yogi, Vikram & Kumar, Pramod & Singh (2020) In the northwestern section of India, which is comprised of the states of Punjab, Haryana, and Rajasthan, there is a significant amount of kinnow cultivation. The investigation of 180 kinnow farmers from three districts in the northwestern part of India, specifically the Fazilka and Bathinda districts of the state of Punjab and the Sirsa district of the state of Haryana, revealed the existence of a number of marketing channels for the marketing of kinnow, each of which has varying levels of efficiency. In spite of what most people think, conventional marketing channels (TMC) really gave a 15–19% larger net gain in the event that price and yield risk was connected with the farms. Farms that are part of value chains that have strong value chain finance (TMC) tend to be more productive than farms that are part of value chains that have poor value chain finance and that include new marketing channels (EMC). These reasons provide an explanation for why farmers continue to have trust in the TMC, as seen by the fact that a share of farms sell their goods via a variety of market channels. The research suggests that there is a need for the development of novel types of marketing channels as well as the coexistence of all of them given that each has its own set of benefits and drawbacks. The report provides recommendations for improving the kinnow value chain so that all of the stakeholders may reap the benefits of such improvements. The improvement of the kinnow value chain can be accomplished through the collectivization of farmers in the form of farmer producer organisations, the availability of technology from a variety of governmental and non-governmental institutions, the successful implementation of an e-marketing app, the development of a crop insurance scheme, and the establishment of a price stabilisation fund for risk reduction.

Bajaj, Kavita & Singh, Sandeep (2020) Fruit flies, also known as Bactrocera dorsalis (Hendel) and Bactrocera zonata (Saunders), are very damaging pests that may cause up to 80, 70, 100 and 60–80% fruit infection, respectively, in peaches, pears, guavas, and Kinnow mandarins. These fruit flies are exceedingly challenging to control since the adults are multivoltine, they have great mobility and fertility, and none of their developmental phases are exposed to the environment. Methyl eugenol, which is found in the parapheromone of Bactocera spp., has a strong pull on the males of these species. During the 2016–2017 growing season, research was conducted in peach, pear, guava, and Kinnow orchards to investigate how fruit flies reacted to methyl eugenol-based fruit fly traps of several colours (red, green, yellow, and the normal clear trap). The findings demonstrated that, when compared to the other trap colours, the yellow trap was, across all four crops, the one that was seen as being the most appealing. The usage of fruit fly traps that are yellow in colour may aid in attracting more fruit flies, which will ultimately lead to a reduction in the population of fruit flies in the respective orchards.

Mahawar, Manoj & Bibwe, Bhushan & Jalgaonkar (2019) It is possible that the connection between the physical qualities of fruits, such as their dimensions, projected areas, volume, and mass, may aid in the prediction of fruit quality in addition to the creation of post-harvesting technology. As a result, the purpose of this research is to determine how accurately linear and nonlinear mathematical models (quadratic, power, and s-curve) can estimate the mass of kinnow mandarin (Citrus reticulata L.) fruit as a function of its axial dimensions, projected areas, and volume. In addition, the models of the mass were provided in three distinct classifications: those based on dimensions, those based on predicted areas, and those based on volumes. In addition, the influence of size grading was investigated and contrasted with the findings of the study including ungraded fruits. When compared to individual grades, the findings indicated that mass modelling, which is based on the dimensions and volume of ungraded fruits, is the more suitable method. It is advised that the quadratic model based on geometric mean diameter ($R2 = 0.956$) and ellipsoid volume ($R2 = 0.955$) be used when attempting to forecast the mass of ungraded fruits with the highest possible level of accuracy. The application in practise One of the most essential parts of packaging is mass-based fruit grading since it not only helps to cut down on the waste of resources that are used in the handling and shipping processes by optimising the packaging forms, but it also improves the marketability of the commodity. Consumers, on the whole, have a preference for fruits that are consistent across dimensions including size, weight, and form. The look, dimensions, and weight of horticultural product are often taken into consideration while classifying it. Because of its precision and efficiency, mass is often used as a grading criteria in automated fruit sorting procedures. This is because of the nature of the process. The existing techniques for rating kinnow essentially provide scores to the fruits according to the dimensional characteristics they possess. As a result, the purpose of this study was to develop a mass modelling of kinnow mandarin based on the selected engineering attributes in such a way that the results could possibly be useful in the development of an accurate automatic grading system for grading based on the combined approach of size and mass. This research gives information that might be relevant for the creation of mass and size based kinnow grading systems. The study focuses on the correlations between fruit mass and axial dimensions, projected areas, and volume.

3. MATERIAL AND METHOD

Experiment-I: Effect of Organic and Inorganic Sources of Nutrition on Growth, Yield; Fruit Quality and Leaf Chlorophyll

OBSERVATIONS RECORDED

3.1 Plant Growth Parameters

3.1.1 Trunk girth

Before and after the experiment, the girth of the trunks of the experimental plants were measured at 15 centimetres above ground. The girth of the tree trunk was determined by using a measuring tape and was recorded in millimetres (cms).

3.1.2 Shoot extension growth

At the conclusion of the growing season, ten shoots from the current season's growth were chosen at random from all over the tree's perimeter, and their length was measured using a measuring tape and represented in centimetres (cms).

3.1.3 Tree spread

Before fertiliser application (BFA) and after fruit harvest (AFH), the spread of each trees was measured using a marked bamboo stick placed horizontally along the tree's East-West and North-South axes (m). Using the following formula, we were able to describe the same idea in terms of a percentage increase in tree spread:

$$\text{Per cent increase in tree spread} = \frac{\text{Tree spread (AFH) - Tree spread (BFA)}}{\text{Tree spread (BFA)}} \times 100$$

3.1.4 Leaf area

Fifty leaves were chosen at random from each of the experimental trees, and leaf area was quantified using a graphical approach; the results were reported as an average leaf area in square centimetres (cm2).

4. RESULTS

4.1 PLANT GROWTH PARAMETERS

4.1.1 Trunk girth (cm)

Table 4.1 displays information on the impact of integrated nutrient management on the trunk girth of Kinnow trees. The findings from both years of research suggest that increasing the trunk girth via comprehensive nutrition management is very effective. RDF + VC + Azospirillum + Trichoderma produced the greatest increase in trunk girth (4.03 cm) throughout the first year of the study (T12). RDF + VC + PSB + VAM (T10) and RDF + VC (T8) trailed closely behind with trunk girth measurements of 3.68 and 3.52 cm, respectively. It is possible that the general role of bio-fertilizers in stimulating nutrients uptake, especially nitrogen, is related to the increase in trunk circumference observed. Nitrogen plays a role in the assimilation of numerous amino-acids, which are then incorporated in proteins and nucleic-acids, which provide framework for chloroplasts, mitochondria, and other structures in which most biochemical reactions take place. This enhancement is attributed, in part, to the fact that the incorporation of biofertilizers and organic manures into the soil, in addition to inorganic fertilisers, led to an increase in the available NPK status, organic carbon, microbial biomass, and dehydrogenase activity. When pomegranate plants were fed a mixture of vermicompost and bio-fertilizers, Aseri et al. (2008) found that their average girth increased. The current result is consistent with the research done by Muhammed et al. (2000) on guava, Hazarika (2011) on bananas, and Singh et al. (2015) on strawberries.

Table 4.1: Effect of organic and inorganic fertilizers on trunk girth increment (cm)

Treatments	2018-2019 Trunk girth(cm)	2019-2020 Trunk girth(cm)	Pooled Data
T_1 : NPK (RDF)-Control	3.03 ± 0.20^{bcd}	3.24 ± 0.15^{bcd}	3.14 ± 0.21^{bcd}
T_2: RDF + *Azotobacter*	2.86 ± 0.11^{b}	3.05 ± 0.12^{bc}	2.96 ± 0.10^{bc}
T_3 : RDF + PSB	2.92 ± 0.13^{b}	3.08 ± 0.17^{bc}	3.00 ± 0.10^{bc}
T_4 : RDF+ VAM	2.81 ± 0.12^{b}	2.93 ± 0.13^{b}	2.87 ± 0.10^{b}
T_5 : RDF + *Trichoderma*	2.74 ± 0.13^{b}	2.93 ± 0.14^{b}	2.84 ± 0.10^{b}
T_6: RDF + FYM	3.15 ± 0.10^{bcde}	3.36 ± 0.10^{bcde}	3.26 ± 0.11^{bcde}
T_7 : RDF + *Azospirillum*	2.79 ± 0.14^{b}	2.98 ± 0.15^{b}	2.89 ± 0.10^{b}

T_8: RDF + VC	3.52±0.10^{def}	3.81±0.10^{def}	3.67±0.15^{def}
T_9: RDF + *Azotobacter* + PSB + VAM	2.94±0.10^{bc}	3.17±0.18^{bcd}	3.06±0.12^{bcd}
T_{10} : RDF + VC + PSB + VAM	3.68±0.10^{ef}	3.97±0.11^{ef}	3.83±0.15^{ef}
T_{11}: RDF + FYM + *Azospirillum* + *Trichoderma*	3.48±0.10^{cde}	3.69±0.10^{cde}	3.59±0.11^{cde}
T_{12}: RDF + VC + *Azospirillum* + *Trichoderma*	**4.03±0.11^{f}**	**4.53±0.17^{f}**	**4.28±0.25^{f}**
T_{13}: PSB + VAM + VC + FYM + *Azotobacter* + *Azospirillum* + *Trichoderma*	**1.53±0.10^{a}**	**1.58±0.10^{a}**	**1.56±0.03^{a}**

Musmade et al. (2009) found that acid lime, Khehra and Bal (2014) found that lemon, and Mir et al. (2013) found that pomegranate, and the current results in Kinnow are in close accord with these other studies.

4.1.2 Shoot extension growth (cm)

Table 4.2 shows how shoot extension growth changes as a result of INM. By analysing the data, we can see that INM had a significant impact on the development of the shoot extension in both years. Growth in shoot extension was measured at 39.53 cm for the control treatment T1 and at 37.99 cm for treatments T12 (RDF + VC + Azospirillum + Trichoderma) and T11 (RDF + FYM + Azospirillum + Trichoderma). A statistically significant difference was seen between the two treatments for shoot extension growth. The involvement of nitrogen, phosphate, and potassium in numerous biochemical activities in plant may account for the increased branch extension development seen in Kinnow plants. Nitrogen, a component of chlorophyll molecules, proteins, nucleo-proteins, amino-acids, amides, polypeptides, and many other organic substances, plays a function in improving the physiological state inside the plant, hence promoting increased shoot development. Phosphorus is essential for plant development since it is used in the production of several phosphorylated chemicals. Potassium may boost development because it plays a role in photosynthesis, respiration, and glucose translocation, and because it activates enzymes involved in the creation of specific peptide bonds during protein synthesis.

Table 4.2: Effect of organic and inorganic fertilizers on shoot extension growth (cm)

Treatments	**2018-2019 Shoot Extension growth (cm)**	**2019-2020 Shoot Extension growth (cm)**	**Pooled Data**
T_1 : NPK (RDF)-Control	**39.53± 0.17^{f}**	**41.45± 0.44^{f}**	**40.49± 0.96^{f}**
T_2: RDF + *Azotobacter*	33.47± 0.03^{b}	33.74± 0.10^{b}	33.61± 0.14^{b}
T_3 : RDF + PSB	33.87± 0.23^{bc}	34.29± 0.18^{bc}	34.08± 0.21^{bc}
T_4 : RDF + VAM	34.56±0.32^{bc}	34.64±0.28^{bc}	34.60±0.04^{bc}
T_5 : RDF + *Trichoderma*	33.57±0.11^{bc}	34.02±0.10^{bc}	33.79±0.23^{bc}
T_6: RDF + FYM	34.15±0.41^{bc}	34.58±0.41^{bc}	34.37±0.22^{bc}
T_7 : RDF + *Azospirillum*	33.54±0.19^{bc}	33.96±0.19^{bc}	33.75±0.21^{bc}
T_8: RDF + VC	34.29±0.31^{bc}	34.69±0.38^{bc}	34.49±0.20^{bc}
T_9: RDF + *Azotobacter* + PSB + VAM	36.31±0.10^{cd}	36.82±0.12^{cd}	36.57±0.26^{cd}
T_{10} : RDF + VC + PSB + VAM	36.57±0.16^{d}	37.13±0.27^{d}	36.85±0.28^{d}
T_{11}: RDF + FYM + *Azospirillum* + *Trichoderma*	37.12±0.11^{de}	37.84±0.11^{de}	37.48±0.36^{de}
T_{12}: RDF + VC + *Azospirillum* + *Trichoderma*	37.99±0.08^{e}	38.27±0.14^{e}	38.13±0.14^{e}
T_{13}: PSB + VAM + VC + FYM + *Azotobacter* + *Azospirillum* + *Trichoderma*	**29.15±0.10^{a}**	**30.53±0.43^{a}**	**29.84±0.69^{a}**

4.1.3 Leaf area (cm2)

Table 4.3 displays information on how INM has impacted the leaf area of Kinnow trees. The findings from both years of research suggest that increasing the leaf area with a nutrient management combination yields the best benefits. RDF + VC + Azospirillum + Trichoderma resulted in the largest leaf area (27.98 cm2) (T12). The next closest in terms of leaf area was RDF + VC + PSB + VAM (T10), with 26.25 cm2, and RDF + VC (T8), with 25.78 cm2. Increased enzyme activity in the plant, such as dehydrogenase, alkaline phosphatase, nitrogenase, and hydrolysis, may account for the larger leaf surface area seen after bio-fertilizer inoculation. T13 (PSB + VAM + VC + FYM + Azotobacter + Azospirillum + Trichoderma) had the smallest leaf area (20.76 cm2). The free-living nitrogen fixer may effect plant development in a number of ways, including nitrogen fixation, microbial balance modification, phosphorus solubilization, pathogen suppression, and the production of compounds that promote leaf growth.

Table 4.3: Effect of organic and inorganic fertilizers on leaf area (cm2)

Treatments	**2018-2019 Leaf area (cm^2)**	**2019-2020 Leaf area (cm^2)**	**Pooled Data**
T_1 : NPK (RDF)-Control	24.10± 0.10^{d}	25.18±0.10^{d}	24.64± 0.10^{cd}
T_2: RDF + *Azotobacter*	22.27± 0.10^{b}	23.10±0.16^{ab}	22.69± 0.12^{ab}
T_3 : RDF + PSB	22.48± 0.10^{bc}	23.34±0.14^{abc}	22.91± 0.10^{ab}
T_4 : RDF + VAM	23.85±0.10^{cd}	24.74±0.13^{cd}	24.29±0.10^{cd}
T_5 : RDF + *Trichoderma*	22.43±0.10^{bc}	23.29±0.10^{abc}	22.86±0.10^{ab}
T_6: RDF + FYM	23.64±0.10^{cd}	24.58±0.20^{cd}	24.11±0.13^{cd}
T_7 : RDF + *Azospirillum*	22.52±0.05^{bc}	23.82±0.10^{bcd}	23.17±0.10^{bc}
T_8: RDF + VC	25.78±0.20^{de}	26.93±0.10^{de}	26.36±0.15^{de}
T_9: RDF + *Azotobacter* + PSB + VAM	23.92±0.26^{cd}	24.65±0.20^{cd}	24.29±0.10^{cd}
T_{10} : RDF + VC + PSB + VAM	26.25±0.10^{ef}	27.10±0.15^{ef}	26.97±0.10^{ef}
T_{11}: RDF + FYM + *Azospirillum* + *Trichoderma*	24.54±0.13^{de}	24.88±0.17^{cd}	24.71±0.10^{cd}
T_{12}: RDF +VC +*Azospirillum*+ *Trichoderma*	**27.98±0.10^{f}**	**29.10±0.32^{f}**	**28.54±0.20^{f}**
T_{13}: PSB + VAM + VC + FYM + *Azotobacter*+*Azospirillum* + *Trichoderma*	**20.76±0.26^{a}**	**22.16±0.20^{a}**	**21.46±0.10^{a}**

4.1.4 Tree spread (%)

Table 4.4 show the impact of INM on the North-South distribution of trees. Tree growth was significantly impacted by INM in both growing seasons.

Table 4.4: Effect of organic and inorganic fertilizers on tree spread N-S (%)

Treatments	**2018-2019 Tree spreadN-S (%)**	**2019-2020 Tree spreadN-S (%)**	**Pooled Data**
T_1 : NPK (RDF)-Control	**12.74±0.12^{g}**	**13.63±0.14^{g}**	**13.19±0.44^{g}**
T_2: RDF + *Azotobacter*	6.86±0.10^{b}	7.57±0.12^{b}	7.22±0.36^{b}
T_3 : RDF + PSB	7.01±0.10^{b}	7.70±0.13^{b}	7.36±0.34^{b}
T_4 : RDF + VAM	7.55±0.20^{bc}	8.12±0.19^{bc}	7.84±0.29^{bc}
T_5 : RDF + *Trichoderma*	8.92±0.10^{cde}	9.57±0.14^{cde}	9.25±0.33^{cde}
T_6: RDF + FYM	8.26±0.20^{cd}	9.05±0.18^{cd}	8.66±0.40^{cd}
T_7 : RDF + *Azospirillum*	7.51±0.14^{bc}	7.83±0.20^{bc}	7.67±0.16^{bc}
T_8: RDF + VC	8.69±0.22^{cd}	9.17±0.20^{cde}	8.93±0.24^{cd}
T_9: RDF + *Azotobacter* + PSB + VAM	10.25±0.17^{de}	10.74±0.25^{de}	10.49±0.25^{de}
T_{10} : RDF + VC + PSB + VAM	10.87±0.10^{def}	11.28±0.17^{def}	11.07±0.21^{def}
T_{11}: RDF + FYM + *Azospirillum*+*Trichoderma*	11.59±0.21^{ef}	12.06±0.14^{ef}	11.83±0.24^{ef}
T_{12}: RDF + VC + *Azospirillum*+ *Trichoderma*	11.61±0.15^{ef}	12.16±0.15^{e}	11.89±0.17^{ef}
T_{13}: PSB + VAM + VC + FYM + *Azotobacter* + *Azospirillum* +*Trichoderma*	**5.66±0.10^{a}**	**6.12±0.10^{a}**	**5.89±0.23^{a}**

5. CONCLUSION

The application of RDF + VC + Azospirillum + Trichoderma resulted in the greatest increase in trunk girth (4.28 cm) throughout the course of the two years taken together (T12). In addition, the trunk girth was larger for the RDF + VC + PSB + VAM (T10) and RDF + VC (T8) treatments. Treatment with PSB + VAM + VC + FYM + Azotobacter + Azospirillum + Trichoderma resulted in a 1.56-centimeter-minimum trunk girth (T13). Maximum shoot extension growth (40.49 cm) was reported in the (T1) NPK (RDF) - control treatment, followed by (T12) RDF + VC + Azospirillum + Trichoderma (38.13 cm) and (T11) RDF + FYM + Azospirillum + Trichoderma (37.48 cm). Minimum branch extension growth of 29.84 cm was achieved by plants treated with PSB + VAM + VC + FYM + Azotobacter + Azospirillum + Trichoderma (T13). With the help of a nutrition management combination, the leaf area dramatically increased. In terms of leaf area, the RDF + VC + Azospirillum + Trichoderma (T12) treatment had the best results (28.54 cm2), followed by the RDF + VC + PSB + VAM (T10) treatment (26.97 cm2) and the RDF + VC (T8) therapy (26.36 cm2). Minimum leaf area was produced by plants treated with PSB+VAM+VC+FYM+Azotobacter+Azospirillum+Trichoderma (T13) (21.46 cm2). Treatment (T1) NPK (RDF) - control showed the greatest N-S plant spread at 13.19%, followed by (T12) RDF + VC + Azospirillum + Trichoderma and (T11) RDF + FYM + Azospirillum + Trichoderma, with 11.89% and 11.83"% N-S plant spread reported, respectively. Minimum plant spread of 5.89 percent was achieved when plants were treated with PSB + VAM + VC + FYM + Azotobacter + Azospirillum + Trichoderma (T13). (T1) NPK (RDF)-control produced the greatest east-west plant spread (14.32%). The plant growth rate was similarly increased by 13.22 and 13.13 percent in the RDF + VC + Azospirillum + Trichoderma (T12) and RDF + FYM + Azospirillum + Trichoderma (T11) treatments. PSB + VAM + VC + FYM + Azotobacter + Azospirillum + Trichoderma had the least amount of plant spread (7.03%) of any treatment (T13). The application of (T10) RDF + VC + PSB + VAM resulted in the highest yield of fruit per plant (565.57 per plant, on average). Additionally, 552.28 was reported per plant when (T12) PSB + VC + Azospirillum + Trichoderma was used. The treatment (T13) of PSB + VAM + VC + FYM + Azotobacter + Azospirillum + Trichoderma yielded the fewest fruits (372.34 plant-1).

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