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EFFECTS OF INTERCROPPING ON GROWTH AND YIELD OF RADISH INTER CROPPED WITH TURNIP AND SPINACH UNDER CLMATIC CONDITIONS OF QUETTA

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ABSTRACT

This experiment was designed to intercrop radish with turnip and spinach in different treatments to evaluate its effect on growth and yield. Results obtained from this experiment proved that intercropping is a reliable method to increase crop production by cultivating different crops together at same land area. Through suitable intercropping pattern, agricultural land can be utilized efficiently and failure of one crop can be covered through other crops. This experiment was carried out at vegetable seed production farm, Quetta. Randomized Complete Block Design (RCBD) with four replications was used to carry out this experiment. Four sets of treatments were used i.e. T1 (Radish as a single crop), T2 (Radish +Turnip), T3 (Radish + Spinach), T4 (Turnip + Radish + Spinach). Seed germination test for radish showed minimum 91.5% (T1) and maximum 93.5% (T4) germination. Minimum and maximum plant height of 31.2 cm (T1) and 38.4 cm (T2) were recorded at the time of harvesting. Longest tuberous root length of 28.8 cm was noted in T3 and shortest 22.9 cm in T2. Single tuberous root weight was affected by intercropping and maximum 471.2 g noted in T3 while minimum 369.6 g in T2. Leaf area was also affected by intercropping pattern and leaf area of 17.2 and 13.3 cm was recorded in T3 and T2. Significant increase in yield per hectare was noticed in T3 with maximum yield of 20.8 tons/ha, while minimum yield was 14.5 tons/ha in T2. In T3 growth of radish was increased in terms of root length, root weight, leaf area, plant height and yield per hectare. Present study revealed that intercropping of radish with spinach would be the most suitable in all aspects.

Keywords: Intercropping, Yield, Replications, Treatments, Leafy, Tuberous.

INTRODUCTION

In general, intercropping means growing at least two different crops at the same cultivation season and in the same area (Kizilsimsek and Erol 2000). The increasing concern over agricultural sustainability favors the maintenance of intercropping systems due to its positive effect on soil conservation and improvement of soil fertility (Jarenyama et al., 2000). The economic efficiency of agricultural production resulting from lower production unit costs (costs per unit of product), is related to the increased soil fertility and the optimization of acreage (Reis, 2002). The practice of growing crops together to enhance productivity and reduce input cost. Intercropping helps to control insect / pest attack, disease, soil erosion and improve soil fertility and lower the risk and chances of crop failure, (Jarenyama et al., 2000). The intercropping system can promote the crop growth and soil fertility and decrease per unit cost of the product, Batista et al (2016) and Silva et al (2017). Riberio et al., (2000) reported that if multiple crops grown together, no additional cost required and farmers can manage this cultivation in available resources and within limited cost.

In another study Rezende et al., (2005) mentioned that intercropping of radish with lettuce were economically beneficial as compared to their monoculture, revenue was increased due to higher production and cast was also minimized. The technique of paired row planting in intercropping system is one way of accommodating the whole population of the base crop and creating interspaces wide enough to accommodate one or two rows of intercrop. Agricultural production and its efficiency is directly related to production cost per unit, it is also related to soil fertility and management of agricultural land. Through better field management, soil fertility can be increased and minimum inputs will be required for land management (Karatas et al., 2005). The most important reason for intercropping is the increased productivity of per unit area and efficient use of land and other resources. Cultivation of leafy with tuberous vegetables provides better use of land and other environmental resources, which results in higher economic yield (Oliveira et al., 2017). The objectives of this experiment were to evaluate the effects of intercropping on growth and yield of

radish, when intercropped with turnip and spinach under climatic conditions of Quetta.

MATERIALS AND METHODS

This experiment was carried out at Vegetable Seed Production Farm, Quetta, Balochistan (30º 10' 59.7720" N & 66º 59' 47.2272" E) during the months of August to November during the year 2018 and 2019. Climatic conditions of the area are semi-arid with average temperature of 24ºC to 26ºC in summer season from May to September, autumn season starts from September and continues until mid-November with average temperature of 12ºC to 18ºC. When experiment was conducted the average temperature of the area was 20ºC to 22ºC.

For this experiment Randomized Complete Block Design was used with four treatments and four replications. Seed germination test was carried out at laboratory to test germination percentage of radish seeds. All field area was leveled, cleaned and prepared through plowing, Tillage and planking (Brintha and Seran 2009). After land preparation and addition of FYM, furrows were made in all plots and seeds of Radish, Turnip and Spinach were sown in rows. Plant to plant distance was maintained at 12 cm while row to row distance was 30cm (Atalla and Abbas 2016). Single local variety of each vegetable was selected for research trial. After 5 days of sowing, all three crops were checked and thinned out at 12 cm spacing. Size of each plot was 1.2 m x 3.0 m, with total number of sixteen plots.

Details of treatments are as follows:

T1: Radish as a single crop, T2: Radish & Turnip in parallel paired rows. T3: Radish & Spinach in parallel paired rows. T4: Radish, Turnip & Spinach in parallel paired rows.

RESULTS

Germination Percentage: Germination test was carried out in laboratory of Vegetable seed production farm under controlled environment 10, 10 seeds were selected randomly for germination test. Test results shows 91 to 93 percent seed germinations under different treatments and replications.

Plant Height (cm): There was no significant difference observed in plant heights among treatments (Table-1). Highest average plant height of 38.4 cm was noted in radish intercropped with turnip (T2). Second highest plant height of 33.9 cm was observed in radish intercropped with spinach (T3) followed by 32.9 cm in radish intercropped with turnip and spinach (T4), height of 31.2 cm was noted in Mono-cropping of radish (T1). In T2 where radish was intercropped with turnip, increase in average plant height may be due to less tuberous root length and weight, which results in increased plant height and growth. In other treatments where the average tuberous root size was higher the plant height was reduced. It means increase in tuberous root decrease the plant height and leaf growth. But no significant difference was observed.

Tuberous root length (cm): Tuberous root length of radish was varied among the treatments (Table-1). Intercropping of radish with spinach produced the lengthiest tuberous roots with average root length of 28.8cm (T3) followed by radish in monoculture cropping pattern with root length of 27.2 cm (T1). Intercropping of radish with turnip and spinach (T4) also results in good root length up to 26.5 cm (T4). Average radish tuberous root length intercropped with turnip was 22.9 cm (T2) and it is the lowest number among treatments. Intercropping of Radish with Spinach results in lengthy roots as compared to other intercropping patterns. It may be due to more nutrients and water availability and less competition of required nutrients for tuberous growth. Results were non-significant because no clear difference was observed among fruit length.

Single Tuberous Root Weight (g): Significant difference was observed in single root weights among treatments (Table-1). Heavier roots with average single tuberous weight of 471.2 g were observed and noted in radish intercropped with spinach (T3) followed by 414.9g in radish intercropped with turnip and spinach (T4). In T1 where radish was sown as a single crop the average weight of 414 g was noted. Radish intercropped with turnip (T2) results in lowest single tuberous root weight which was 369.6 g and it also affect the yield per hectare due to small fruit size.

Table 1: Plant Height (cm), Root Length (cm), Single Root Weight (g)

Treatment	Plant Height (cm)	Root Length (cm)	Single Root Weight
T1	31.2	27.2	414.0
T2	38.4	22.9	369.6
T3	33.9	28.8	471.2
T4	32.9	26.5	414.9
F test	*	*	**
P-Value	0.09	0.10	0.00

F test: - **: P<0.01; *: P<0.05

Leaf Area (cm): Leaf area is another important factor through which we can predict the crop yield and growth. Reasonable leaf area is important for photosynthesis good yield. Small leaf area not enough to absorb maximum light and play role in photosynthesis which results in small fruit size and low yield. In this experiment significant difference was observed among leaf area (Table-2). Largest leaf area was noted in radish intercropped with spinach (T3), with average leaf area of 17.2 cm and it results in higher yield and crop growth. In another three treatments no significant difference was observed, as in radish as a monoculture sole crop the average leaf area was15.2cm (T1) followed by 14.5cm in (T4) where radish was intercropped with turnip and spinach. In T3 where radish was sown with turnip results in smallest leaf area of 13.3 cm.

Yield per Hectare (tons): Intercropping of radish with different crops affect its growth and yield and significant difference was observed among the treatments (Table-2). Radish yield of (20.8 tons/ha) was the highest one in (T3) where radish was intercropped with spinach. This study revealed that radish can give best results when planted with spinach. It may be due to nature and different nutrient requirement of both crops. Second highest average yield was in (T1) monoculture cropping pattern which was (18.2 tons/ha). In T3 results were also better with average per hectare yield of (17.3ton/ha). In (T2) radish intercropped with turnip results in lower yield (14.5 ton/ha).

Table 2: Leaf Area (cm), Yield per Hectare (ton)

Treatment	Leaf Area (cm)	Yield per Hectare (ton)
T1	15.2	18.2
T2	13.3	14.5
T3	17.2	20.8
T4	14.5	17.3
F test	**	**
P-Value	0.01	0.00

F test: - **: P<0.01; *: P<0.05

The present study revealed that intercropping affect the growth, yield, leaf area, tuberous root weight and size of radish. The radish yield was (20.8 tons/ha) when intercropped with spinach (T3), which was the highest yield followed by (T1) in monoculture and (17.3 tons/ha) in T4. A low yield (14.5 ton/ha) was obtained from T2 when radish was intercropped with turnip. It may be due to crop competition or resource depletion. Leaf area was not influenced by spinach and it was 17.2 cm in T3. In T1 and T3 leaf area was in maximum range (15.2 and 17.1cm) when radish was sown independently as a mono-crop and with spinach. Single tuberous root weight was obtained up to 471.2 g in T3 when radish was intercropped with spinach. T1 and T4 produced almost same tuberous root weigh that was 414 and 414.9 g. In T3 the average weight was 369.6 g which was too low as compared to other treatments. Tuberous root length was also better in T3 (28.8 cm) followed by T1 (27.2 cm) and T4 (26.5 cm) as compared to T2 (22.9 cm).

DISCUSSION

Research experiments shows effects of intercropping on crop growth, yield, plant height, leaf area etc. Intercropping of turnip with faba bean results in higher crop production and it increased the yield of turnip by 50.87 to 51.13 percent. Intercropping of radish with faba bean also results in 66.74- 67.48 increase in fresh fruit yield (Atallah and Abbas 2017). In other research experiment radish was intercropped with cabbage to evaluate the effect on yield and monetary returns. Results of this study shows that intercropping of radish+cabbage is beneficial and it produced significantly higher yield than other cropping combinations (Gawade, et al. 2002).

Increasing productivity per unit area is one of the important reasons for cultivating two or more crops together. Cultivation of tuberous + leafy vegetables provides efficient land utilization and other resources, which results in higher economic return (Oliveira et al, 2017).

According to the Rezende et al. (2005), intercropping of radish with lettuce results in increased net returns of 4.13 and 4.53 with profit margins of 75.77 and 77.94% respectively. Which was higher as compared to Mono-cropping system.

CONCLUSION

From this study we concluded that intercropping of different crops at the same time and same land area results in higher crop production with better land management. We have intercropped radish with

turnip and spinach in different combinations. Obtained results shows that radish produced higher yield when intercropped with spinach.

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