European Journal of Molecular & Clinical Medicine
ISSN 2515-8260 Volume 07, Issue 07, 2020

Effect Of Legume Intercropping And Straw Mulching On Growth And Yield Of Wheat Crop

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ABSTRACT: ***The field experiment was conducted to study the "Agronomic modifications for wheat production in organic farming" on sandy loam soil, medium in organic carbon and low in available N and high in available P and K was conducted at Students' Research Farm, Khalsa College, Amritsar during rabiseason of 2015-16. The experiment was laid out in randomized block design with eight treatments, having different combinations of planting methods, legume intercropping and straw mulching i.e.*** T_1 ***: Flat sown wheat,*** T_2***: bed planted wheat,*** T_3***:*** T_2***+ intercropping gram in centre,*** T_4***:*** T_2***+ intercropping lentil in centre,*** T_5***: Paired rows of wheat and gram on bed,*** T_6***: Paired rows of wheat and lentil on bed,*** T_7***:*** T_5***+ straw mulching and*** T_8***:*** T_6***+ straw mulching replicated four times. Maximum plant population (91.8*** m^2***) plant height (88.9cm), Leaf area index (3.34), dry matter accumulation (90.2*** qha^{-1}***),tillers count (273.8*** m^2***), grain yield (35.1*** qha^{-1} ***), straw yield (52.1q*** ha^{-1}***) were recorded in bed planting, paired row of wheat and gram + straw mulch (*** T_7***) which was followed by bed planting, paired row of wheat and lentil+ straw mulch (*** T_8***) were significantly superior over sole wheat (*** T_2***,*** T_1***) and at par with paired rows of wheat with gram and lentil (*** T_5***,*** T_6***), wheat intercropped with gram and lentil (*** T_3***,*** T_4***) without straw mulch.***

Key words: Bed planting, Legume inter cropping, Straw mulching, Organic farming

1. INTRODUCTION

Wheat (*Triticum aestivum*) is a staple food grain which was originated in South-West Asia and belongs to family Gramineae. It covers a largest area in world so it placed at premium position. The best temperature for wheat growth and development ranges between 20-25 degree celsius. It is a good source of carbohydrates, protein, minerals and amino acids. As a human population is increasing day by day, the demand of cereal crops production is also increased. Legumes are important crops which helps in fixing the atmospheric nitrogen and improving the soil fertility, productivity and crop yield. Wheat requires a large amount of nitrogen for its vegetative and reproductive development (Sharma (2020); ChitraMani & Kumar, P. (2020); Sharma, M., & Kumar, P. (2020); Chand, J., & Kumar, P. (2020); Naik, M., & Kumar, P. (2020); Kumar, P., & Naik, M. (2020); Kumar, P., & Dwivedi, P. (2020);

Yaman, (2020); Yaman and Kumar, (2020); Devi, P., & Kumar, P. (2020); Kumari, P., & Kumar, P. (2020); Kaur, S., & Kumar, P. (2020); Devi, P., & Kumar, P. (2020); Sharma, K., & Kumar, P. (2020); Kumar, S. B. P. (2020); Devi, P., & Kumar, P. (2020); Chand, J., & Kumar, P. (2020). But if we can intercrop the wheat with legume, it can decrease the amount of chemical fertilizers and increases the yield by fixing the atmospheric nitrogen. There is no doubt that with the use of modern technology the production is increased at high level but at side by side it enhances the problems like land degradation and long residual effect on soil etc. Organic farming is a subsistence approach which helps in minimizing hazards caused by intensive agriculture during developing natural system of nutrient, water, weed, insect- pest and disease execution. Additional agronomic innovations which can improve productivity protect resources and decrease weed threat needs to consider like bed planting, legume intercropping, straw mulching, irrigation management, crop geometry etc (Lampkin, 1990; Kumar, P. (2019); Kumar, D., Rameshwar, S. D., & Kumar, P. (2019); Dey, S. R., & Kumar, P. (2019); Kumar et al. (2019); Dey, S. R., & Kumar, P. (2019); Kumar, P., & Pathak, S. (2018); Kumar, P., & Dwivedi, P. (2018); Kumar, P., & Pathak, S. (2018); Kumar et al.,2018; Kumar, P., & Hemantaranjan, A. (2017); Dwivedi, P., & Prasann, K. (2016). Kumar, P. (2014); Kumar, P. (2013); Kumar et al. (2013); Prasann, K. (2012); Kumar et al. (2011); Kumar et al. (2014).

2. MATERIAL AND METHODS:

The studies were carried out at Students' Research Farm, Khalsa College, Amritsar (Latitude of 31º 38′ N and Longitude of 72º 52′ E) during *rabi Season* of 2015-2016. The soil of the experimental plot wassandy loam with pH 7.6. Two cultivations (by using cultivator) followed by a ploughing (through chisel plough) and planking were used for basal land preparation. The rest of cultural practices (drilling, bed formation etc.) were done according to the needs of treatments. The treatments were comprised of; flat planting of wheat, bed planting of wheat, bed planted wheat intercropped with gram and lentil and use of straw mulch. Experiment was laid out in randomized complete block design with four replications using a net plot size of 4.05 m×2.8 m.Wheat variety WH 1105 was used.
Raised beds and furrows were made manually by bed planter and conventional land preparation by spade. According to the treatments 67.5 cm wide beds were made. The height of beds was 15 cm. Seed rate used was 75 $Kgha^{-1}$. The date of sowing was 16 November, 2015. Seeds were sown in rows in both bed and conventional methods. For beds, seeds were sown in one and two rows according to the different treatments on beds. For conventional method, row-to-row distance was 20 cm. In the row seeds were sown continuously and covered with soil properly. Gram and lentil crops were interplanted in between the strips of wheat on the same day with the help of single row hand drill. Other agronomic practices (irrigation, plant protection measures etc.) were kept uniform for all treatments. Data regarding plant population, plant height (cm), number of tillers per square meter, grain yield (kg ha^{-1}), biological yield (kg ha^{-1}) and harvest index (%) were analyzed statistically by employing CPCS-I method (Cochran and Cox, 1963).

3. RESULTS AND DISCUSSION

Table Emergence Count. The data presented in Table 1 showed that the emergence count did not influence significantly due to different treatments and indicating a uniform crop stand in all the experimental plots.

1: Effect of legume intercropping and straw mulching on growth parameters of wheat (*Triticumaestivum* L.)

Treatments	Growth parameters				
	Emergence count (m^2)	Plant height (cm)	Leaf area index (LAI)	Dry matter accumulation (qha^{-1})	Tillers count (m^2)
T_1	89.9	80.8	2.92	76.5	252.5
T_2	90.4	83.0	3.20	82.9	262.9
T_3	91.2	84.1	3.28	87.9	271.5
T_4	90.9	83.8	3.27	87.7	266.6
T_5	90.6	87.9	3.25	86.5	264.9
T_6	90.4	87.4	3.24	86.3	263.8
T_7	91.8	88.9	3.34	90.2	273.8
T_8	91.6	88.2	3.30	88.9	273.7
C D (p = 0.05)	NS	3.21	0.19	5.17	10.2

Plant Height. Data on plant height showed that plant height affected significantly with bed planting, legume intercropping and straw mulching at harvest. Maximum plant height was recorded in paired rows of wheat and gram + straw mulch (T_7) and it was statistically at par with paired rows of wheat and lentil + straw mulch (T_8), paired rows of wheat with gram and lentil without straw mulch (T_5, T_6), but significantly higher plant height than wheat intercropped with gram and lentil without straw mulch (T_3,T_4) and sole wheat (T_2).Among various treatments, the lowest plant height (80.8cm) at harvest was recorded in flat sown wheat (T_1). It may be due to uniform distribution of plants and reduction of competition in bed planted, legume intercropped and straw mulched plots which helps the plant to use the available resources in better way because legume intercrop provide nitrogen to crop and straw mulch suppress weed growth. Khan *et al.* (2005) also gave similar results.

Leaf Area Index (LAI). The perusal of data in Table 1 revealed that highest value of leaf area index was observed in paired rows of wheat and gram + straw mulch (T_7) which was significantly better than sole wheat (T_2) at 120 DAS and at par with paired rows of wheat and lentil + straw mulch (T_8), wheat intercropped with gram and lentil (T_3,T_4) and paired rows of wheat with gram and lentil without straw mulch (T_5,T_6). Lower leaf area index was observed in flat treatment (T_1).This was due to significantly more plant height under bed planted, legume intercropped and straw mulched plot as compared to non intercropped and non mulched treatments which lead to more interception, absorption and utilization of solar radiation thereby resulting in more accumulation of photosynthates. Similar results were found by Chakrabort*yet al*. (2010).

Dry matter accumulation. The data in Table 1 revealed that dry matter accumulation for paired rows of wheat and gram + straw mulch (T_7) which was followed by paired rows of wheat and lentil + mulch (T_8) . Treatments T_7, T8 are significantly better than sole wheat (T_2) and at par with wheat intercropped with gram and lentil (T_3,T_4)and paired rows of wheat with

gram and lentil without straw mulch (T_5,T_6).The lowest dry matter accumulation in flat planted wheat (T_1) might be due to more weed competition and less available nutrient fixed by legume intercrop. These findings are in line with Quanqi*et al*. (2008)

Tillers count. The data presented in Table 1 showed that harvest maximum tillers were observed in paired rows of wheat and gram + straw mulch (T_7) which was followed by paired rows of wheat and lentil + straw mulch (T_8).Treatments T_7,T_8 have significantly more number of tillers than sole wheat (T_2) and at par with wheat intercropped with gram and lentil (T_3,T_4) and paired rows of wheat with gram and lentil without straw mulch (T_5,T_6).The lower number of tillers observed in sole wheat might be due to limited nutrient supply and less availability of moisture in sole wheat than intercropped and mulched treatments. Similarly it was observed by Upadhyay and Tiwari (1996).

Grain Yield. The data with respect to grain yield is presented in Table 2 which showed that highest grain yield 35.1(qha^{-1})was recorded in paired rows of wheat and gram + straw mulch (T_7), which was followed by paired rows of wheat and lentil + straw mulch (T_8). Treatment T_7 and T_8 significantly differ than bed sole wheat (T_2) but statistically at par with wheat intercropped with gram and lentil (T_3,T_4) and paired rows of wheat with gram and lentil without straw mulch (T_5,T_6). Flat planted treatments (T_1) produce minimum 28.4 (q ha-1) grain yields than all other treatments. Treatment where legume intercropping and straw mulching is not performed , produce less yield because of higher weed competition and non availability of nitrogen whereas it become available in legume intercropped and straw mulched treatments.The results were similar to finding of Khan *et al*. (2005).

Table 2: Effect of leume intercropping amd straw mulchin on grain yield (q ha^{-1}), straw yield (qha^{-1}) and harvest index (%) of wheat (*Triticumaestivum* L.)

Treatments	**Grain yield (q ha^{-1})**	**Straw yield (q ha^{-1})**	**Harvest index (%)**
T_1	28.4	46.1	38.1
T_2	31.5	49.1	39.0
T_3	34.4	51.3	40.1
T_4	34.1	51.1	40.0
T_5	34.0	51.0	40.0
T_6	33.9	50.9	39.9
T_7	35.1	52.1	40.2
T_8	34.7	51.7	40.1
C D (p = 0.05)	2.15	2.50	NS

Straw yield. The data in Table 2 presentedthat higher straw yield 52.1(q ha^{-1})was recorded in paired rows of wheat and gram + straw mulch (T_7) which was followed by paired rows of wheat and lentil + straw mulch (T_8). Treatment T_7 and T_8 significantly differ than sole wheat (T_2) but statistically at par with wheat intercropped with gram and lentil (T_3,T_4) and paired rows of wheat with gram and lentil without straw mulch (T_5,T_6).Flat planted treatments (T_1) produce minimum 46.1q ha^{-1} straw yield than all other treatments.Highest straw yield in bed planted, legume intercropped and straw mulched treatment was due to fact that legume crop provide nitrogen and better utilization of N in bed planting due to greater weed suppression in less spacing and by straw mulch. Similar results were found by Singh (1992).

Harvest index. The data in Table 2 regarding harvest index indicates that different treatments had non-significant effect on harvest index. This may be due to the reason that for every increase or decrease in the economic yield (grain yield) there was corresponding increase or decrease in the biological yield of crop. The data represented that maximum harvest index (40.2) was recorded in paired rows of wheat and gram + straw mulch (T_7) whereas minimum (38.1) harvest index was observed in flat planted wheat (T_1).

4. CONCLUSION

It was concluded that plant population, plant height, tillers count, leaf area index , dry matter accumulation, grain yield, straw yield and harvest index were maximum in bed planted, legume intercropped and straw mulched treatments than sole wheat. Among different intercropping systems, highest grain yield, straw yield and benefit cost ratio were observed under bed planting, paired rows of wheat and gram + straw mulch.

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