Journal for Research in Applied Sciences and Biotechnology
ISSN: 2583-4053
Volume-2 Issue-2 || April 2023 || PP. 182-192
www.jrasb.com
https://doi.org/10.55544/jrasb.2.2.27

Comparing System of Wheat Intensification with Normal Practices Under Different Levels of Organic and Inorganic Fertilizer in Southeast Region of Afghanistan

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www.jrasb.com || Vol. 2 No. 2 (2023): April Issue

Received: 03-04-2023 **Revised:** 24-04-2023 **Accepted:** 04-05-2023

ABSTRACT

A field experiment was conducted to study the influence of NPK and FYM under normal practice and system of wheat intensification (SWI). The soil of the experimental area was sandy loam with pH (8.4); and available N (117.3 kg ha^{-1}), medium in available P (13.85 kg ha^{-1}) and high in available K (270 kg ha^{-1}). Mazar 99 variety of wheat was chosen for the study. The experiment was laid out in split plot design with 24 treatments combination and three replications on a plot size of 1.5 x 3 m. Different cropping system (Broadcast method of sowing and system of wheat intensification) and different levels of NPK (50, 75 and 100%) were taken in main plot. Different levels of farm yard manure (0, 20, 40, 60, 80 and 100%) were assigned to sub plot in a split plot design. Application of 100 percent RDF under system of wheat intensification significantly influenced growth and growth attributes of wheat at different crop growth stages. Application of 100% RDF under system of wheat intensification (SWI) registered significantly higher plant height (23.4, 52.3, 77.7 and 82.9 cm), and dry matter accumulation (60, 257, 753 and 964 gram) at tillering, blooming, flowering and maturity stages and number of leaves (1130.0, 1722.3 and 2020.8) and number of tillers (187.9, 280.2 and 310) of wheat was also registered higher in same treatments at tillering, blooming and flowering stages of wheat respectively as compared to rest of the treatments.

Different treatments of cropping system and different levels of RDF and FYM significantly influenced yield and yield attributes of wheat. Among the cropping system, M_4 (100% RDF + SWI) registered significantly higher grain yield (3794.3 kg ha^{-1}) and straw yield (6096.8 kg ha-1) as compared to rest of the treatments. Application of 100 percent farm yard manure recorded significant and maximum grain yield (3553.7 kg ha^{-1}) as compared to rest of the treatments. While, the minimum grain yield (3060.8 kg ha^{-1}) was recorded in S1 due to application of 0% FYM. Similarly, application of 100 percent farm yard manure recorded significantly higher straw yield (5935.5 kg ha^{-1}) as compared to rest of the treatments. However, the lower grain yield (3060.8 kg ha^{-1}) and straw yield (5373.4 kg ha^{-1}) was observed in S_1 due to application of zero percent farm yard manure. The interaction of 100% RDF + SWI with 100 % FYM showed highest grain yield (4060.0 kg ha^{-1}) and straw yield (6450.0 kg ha^{-1}) as compared to rest of the treatments. vOn the basis of economic analysis it is concluded that wheat cv. 'Mazar 99' sown under system of wheat intensification treated by 100% recommended dose of fertilizer (120-60-60 kg NPK/ha) accompanied with 20% N through FYM proved to be the most remunerative dose which will increase the grain yield of wheat by 33 percent as compared to M_1S_1 due to application of 100% RDF + 0% FYM under broadcast method of sowing. However, SWI will increase the net return by 36 percent as compared to broadcast method of sowing.

Keywords- broadcast method, SWI, RDF, FYM, growth, yield, quality, economy, wheat.

I. INTRODUCTION

Wheat (*Triticum aestivum* L.) is one of the most important cereal crops which ranks first among the world food crops, in terms of cultivated area (223.56 m ha) or production (689.95 mt) and with productivity of (3086 kg ha^{-1}) Wheat, with its root ramifying into the depth of human culture has an evolutionary history

ISSN: 2583-4053
Volume-2 Issue-2 || April 2023 || PP. 182-192
https://doi.org/10.55544/jrasb.2.2.27

parallel with history of human civilization itself. Even today it decides the feast or famine for millions of people. Current total wheat demand in Afghanistan is approximately 7 million metric tons and expected to increase to about 12 million metric tons by the year 2030. Current domestic production is only 4.2 million metric tons resulting in a 40% shortage. Afghanistan over the last decade has received enormous financial support particularly in the agriculture sector. In addition to NGOs, Ministry of Agriculture, Irrigation and Livestock (MAIL) have also invested hugely in agriculture production with the aim to make Afghanistan self-sufficient as agriculture producing country, which nonetheless have had mixed results. Thus, there is need for strategic development of agriculture in the sense that it contributes to sustainable rural economic growth and also facilitates Afghan citizen's access to sufficient food mainly in rural areas. To do so, this requires introduction of modern agro techniques like System of wheat intensification (SWI) and application of recommended dose of fertilizer and utilization of natural resources. (Hekmat *et al.*, 2017).

The productivity of a crop is controlled by many factors of which the mineral nutrition especially of nitrogen, phosphorus and potassium are by and large. The cruising population is now confronted by a major shortage of plant produce and there is a worldwide demand to produce high yielding quality crops to meet the ever increasing population requirements. Better soil, crop and nutrient management practices play a pivotal role to achieve this. This would narrow down the yield gap between achievable and actual yields besides furnishing valuable feedback information regarding yield sustainability. The indiscriminate use of inorganic fertilizers for the past 50 years without any addition of organic manures resulted in the large scale deficiency of micro nutrients which play an important role in enhancing the quality and quantity of the agriculture produce though their increment in enzyme system and photosynthesis. Further, nutrient loses in inorganic fertilizer is very high and loss of nutrients like NO3 sometime leads to water pollution.

On accounting of continuing world energy crisis and spiraling price of chemical fertilizer, the use of organic manure as a renewable source of plant nutrient is assuming importance. In this endeavor proper blend of organic and inorganic fertilizer is important not only for increasing yield but also for sustaining soil health (Baloch *et al*., 2010 and Bakht *et al*., 2007). Wheat is an important cereal crop and requires a good supply of nutrients especially nitrogen for its growth (Kumar *et al*., 2004) and yield. Application of farm manure ameliorates the soil permeability (Bali *et al.*, 1986) and improves soil fertility. Soil compaction can be decreased with the use of soil organic matter (Acharya *et al*, 1988). Application of organic materials alone or in combination with inorganic fertilizers helped in the proper nutrition and maintenance of soil fertility (Sameem *et al.*, 2002). Hussain *et al.* (1988) reported that the efficiency of chemical fertilizers increased with the use of organic manures. Continuous use of chemical fertilizers is assumed to be a major cause of deterioration of soil health and water pollution. To maintain high productivity and sustainability of soil and crop, balanced use of both mineral fertilizer and organic manures is indispensable. Under such a condition, there is a great urgency to explore an alternate source, which can supplement partially or wholly the use of costly input i.e., chemical fertilizers and also to protect the fragile ecosystem. To overcome the problem of nutrient deficiency and to increase wheat yield, the farmers are applying chemical fertilizers. However, the chemical fertilizers are expensive and the small farmers cannot afford to use these fertilizers in suitable amount and balanced proportion. Under such condition integrated use of chemical and organic fertilizer/manures can play an important role to sustain soil fertility and crop productivity. Among many factors of crop production, the pattern of planting is of great significance, as it not only determined the proper crop stand establishment but also the productivity of individual plants through balancing the use of inters tillage devices. Since the conventional methods of close drilling and broadcast do not afford to free working of inter tillage devices for effective weed control, hence there is a need to develop new system of sowing which besides giving proper stand, also undertake inter tillage operations conveniently.

II. METHODOLOGY

A field experiment was conducted in Gardiz, Paktia, Afghanistan during the spring season of 2018-19 at Agronomy Research Farm, Department of Agronomy, Faculty of Agriculture, Paktia University, Gardiz, Paktia, Afghanistan to study the influence of NPK and FYM under normal practice and system of wheat intensification (SWI).The soil of the experimental area was sandy loam with pH (8.4); and available N (117.3 kg ha^{-1}), medium in available P (13.85 kg ha^{-1}) and high in available K (270 kg ha^{-1}). Mazar 99 variety of wheat was chosen for the study. The experiment was laid out in split plot design with 24 treatments combination and three replication on a plot size of 1.5 x 3 m. Different cropping system (Broadcast method of sowing and system of wheat intensification) and different levels of NPK (50, 75 and 100%) were taken in main plot. Different levels of farm yard manure (0, 20, 40, 60, 80 and 100%) were assigned to sub plot in a split plot design. After the final field preparation, the seeds of 'Mazar 99' wheat were sown at the rate of 100 kg ha^{-1} at row spacing 20 cm in respect of normal sowing. SWI sowing required 25 kg ha^{-1} of quality seed, which was one-quarter of the amount of seed that was used for broadcast sowing. Before the sowing, healthy, well-

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developed seeds were selected by putting all the seeds into a 20% saltwater solution and discarding those less-viable seeds which floated on the surface. The remaining seeds were treated with a biological mixture of 2 kg of well-decomposed compost or vermicompost, 3 L of cow urine, and 2 kg of jaggery (unrefined sugar), well-mixed together in an earthen pot with 10 L of warm water (60°C). The seeds were soaked in this mixture for 6–8 h, in successive lots of 5 kg. The seeds were then separated from the mixture by filtration and washed with clean water.

The treated seeds were then kept in the shade for 10–12 h, wrapped in rough linen (gunny bag), and during this period the seeds fully sprouted. The sprouted seeds were sown in the field by dibbling, planting two seeds per hill, with the hills spaced in a square pattern of 20 × 20 cm apart. Seeds were sown at a depth of 2.5–3.0 cm, the soil having sufficient moisture to germinate the seeds. Any extra seeds (>2) that germinated in a hill were removed to reduce inter-plant competition. For recording the growth parameters, five plants from sample row of each plot were taken at random and tagged which were utilized for recording observation related to growth and yield attributes. The plant height of the five randomly selected plants was measured from the base of the plant to the base of the first fully opened leaf at tillering, blooming, flowering and at maturity and was expressed in cm. Dry weight of plants were determined by drying the plant samples (taken from per running meter row length from border area) in a hot air oven at 70 to 750C. Then, average dry weight per running meter was recorded. With the help of steel made quadrangle of one square meter, sampling area was randomly earmarked and number of tillers produced in m^{-2} area was counted and mean values were recorded. Ten spikes were randomly selected and measured from base of the spike up to upper most grain.

Finally, the average values on length of spike were computed. For filled grains per spike ten spikes were randomly selected and filled grains were separated from unfilled grains of each spike and the average numbers of filled grains in each spike were computed. For 1000 grain weight 1000-grain of the crop from each plot was counted and average values were computed. Straw yield was worked out by subtracting respective total grain weight from the total biomass. Later the yield was converted in to kg ha^{-1}. Analysis of variance procedure was followed for the statistical analysis of data based on RCBD with split plot arrangement. Means was compared using least significant differences (LSD) test at $P \leq 0.05$ upon significant F-test (Jan et al., 2009).

III. RESULT AND DISCUSSION

1. Effect of Recommended Dose of Fertilizer (RDF) and System of Wheat Intensification (SWI) on growth, yield, quality and economic of wheat

1.1 Effect of RDF and SWI on growth and growth attributes of wheat:

Different cropping system + RDF and different levels of farm yard manure significantly influenced growth and growth attributes of wheat at different crop growth stages.

Application of 100 percent RDF under system of wheat intensification significantly influenced growth and growth attributes of wheat at different crop growth stages. Application of 100% RDF under system of wheat intensification (SWI) registered significantly higher plant height (23.4, 52.3, 77.7 and 82.9 cm), and dry matter accumulation (60, 257, 753 and 964 gram) at tillering, blooming, flowering and maturity stages. Similarly, the number of leaves (1130.0, 1722.3 and 2020.8) and number of tillers (187.9, 280.2 and 310) of wheat were also registered higher in same treatments at tillering, blooming and flowering stages of wheat respectively as compared to rest of the treatments. The increments in growth and growth attributes due to application of 100 percent RDF under system of wheat intensification could be supported by fact that when nitrogen is adequate amount, sufficient protein would be produced, which allowed the plant tissues to grow larger and, therefore, brought about larger surface area for photosynthesis. In other words, the adequate supply of nutrient level exhibited to increase chlorophyll formation and stimulated rapid rate of photosynthetic activity, consequently recording higher growth and growth attributes in comparison to 75% and 50% RDF. Similar results have been reported by Ramakrishna *et al.* (2007). Significantly higher plant height, number of leaves, number of tillers and dry weight was recorded in SWI over normal practice. Significant improvement in all growth parameters at all crop growth stages could be ascribed for its effectiveness to modify environmental conditions of plants by proper distribution of plants over ground area, resulting in increased interception, absorption and utilization of photo synthetically active radiation (PAR) thereby resulting in higher photosynthesis. These results are in close conformity with the findings of Jat and Singh (2004) who have also reported higher growth attributes under SWI over broadcasting. It might also be due to efficient utilization of moisture and nutrient.

1.2 Effect of RDF and SWI on yield and yield attributes of wheat:

The data on yield and yield attributes of wheat were statistically analyzed and have been presented in table 4.6 and 4.7. Yield and yield attributes showed positive response to 100 percent recommended dose of fertilizer under system of wheat intensification (SWI). Among main treatments significantly higher spike length (11.8 cm), number of grains per spike (27.3), 1000 grain weight (35.4 g), grain yield (3794.3 kg ha^{-1}), straw yield (6096.8 kg ha^{-1}) and harvest index (38.3) were registered in M4 due to application 100% RDF under system of wheat intensification as compared to rest of the

ISSN: 2583-4053
Volume-2 Issue-2 || April 2023 || PP. 182-192

https://doi.org/10.55544/jrasb.2.2.27

treatments. Distinct positive effect of NPK levels were noticed on these yield attributes. All these parameters attained higher values with increasing NPK levels up to 100% RDF.

Nitrogen (N) is an important constituent of chlorophyll and so, if applied adequately stimulates photosynthesis in plants. Thus, at higher N levels, there would have been more photosynthetic activity in plant. In wheat, the sink lies in spike and grains. Therefore, under adequate N supply there would have been greater translocation of photosynthates from leaves via stem to sink site *i.e*. spike and grains. This resulted in production of longer and heavier spikes with more grains spike-1. The increase in yield attributes at higher levels of phosphorus under 100% RDF compared to 75% and 50% RDF might be due to increase in supply of food materials. It is intimately connected with the conversion of starch to sugar. Thus, it is involved in photosynthesis. Since phosphorus is a constituent of nucleic acid, phytin and phospholipids, its increased removal resulted into better growth of plant, finally resulting into increased yield. Phosphorus is essential in laying down the primordial for the reproductive parts of the plants. Being constituent of majority of enzymes responsible for transformation of energy, carbohydrates and fat metabolism, it also plays dominant role in respiration of plants. Although maximum absorption occurs during flowering stage, plants without adequate phosphorus in the seedling stage are greatly related in growth and development resulting in reduced photosynthetic area, fewer tillers per plant a substantially reduced root system. Patil in 2003 also observed that spike length, grains spike^{-1} and 1000-grain weight increased with phosphorus fertilization. For these reasons better performance of maturity parameters was found associated with plants supplied with sufficient amount of phosphorus. These facts were confirmed by Jat *et al.* (2013). The high values of yield attributes associated with higher level of potassium application under 100% RDF might be due to its greater removal and active participation in all structure, carbon assimilation, photosynthesis, starch formation, translocation of protein and sugar, entry of water into plants root and development etc. Adequate potassium had direct influence on increasing the removal of nitrogen which, in turn, might have increased the plant height. Increased growth parameters under adequate potassium supply was responsible for better performance of yield attributes which increased with higher rate of fertilizer consisting of greater amount of potassium under 100% RDF.

Similarly, A careful observation clearly indicates that SWI throw, in general better results than normal practice for different yield attributing characters namely, spike length, grains spike^{-1} and 1000-grain weight, higher grain yield, straw yield and harvest index.

Variations in the yield attributes of wheat might be due to beneficial effect of the treatment. Uniform distribution of plants over cropped area and check-row sowing of plants to harvest maximum radiation through its greater penetration in crop canopy result in higher productivity (Kler and Bains, 1992). SWI sowing showed higher photo synthetically active radiation interception (PARI) and yielding ability at recommended inputs. The beneficial effect of line and cross sowing has been reported by several researchers (Singh *et al*., 1993). Similar results were reported by Singh *et al.* (1993), Jat and Singhi (2004) and Pandey and Dwivedi (2007) in which cross sowing method was shown to be superior over all other methods of wheat planting.

1.3 Effect of RDF and SWI on quality parameter of wheat:

The protein content of wheat was influenced by various treatments of cropping systems, farm yard manure and their interaction effect. Among the main cropping, M_4 (100% RDF + SWI) registered significantly higher protein content (10.81%) as compared to M_3 (10.68%), M_2 (10.41%) and M_1 (10.18%) respectively.

Accumulation of protein in grain and straw under adequate N supply might be accounted to continuous availability of nitrogen for protein synthesis. Contrary to this, limited amount of available nitrogen conspicuously associated with lower rate of N might have failed to meet nitrogen requirement for protein synthesis, resulting into low protein percentage. Phosphorus has been reported to play a vital role in the transformation of ammonical ions into protein molecules and thereby increases the nitrogen removal and protein synthesis. Furthermore, increase in level of fertility resulted in increase in NPK content in grain which ultimately increases protein content also. It might be due to higher nutrients application provides congenial surrounding for better root growth and distribution which enhances the scope to explore the nutrients from the greatest soil volume.

Table 1: Effect of cropping system and integrated nutrient management on plant height (cm) at different crop growth stages in wheat

Treatments	At tillering stage						Mean	At blooming stage						Mean	At flowering stage						Mean	At maturity stage						Mean
	S_1	S_2	S_3	S_4	S_5	S_6		S_1	S_2	S_3	S_4	S_5	S_6		S_1	S_2	S_3	S_4	S_5	S_6		S_1	S_2	S_3	S_4	S_5	S_6	
M_1	17.5	17.9	18.3	18.7	18.8	19.0	**18.4**	44.0	45.7	45.8	46.0	46.3	46.6	**45.7**	68.0	69.9	70.1	70.2	70.4	71.0	**69.9**	75.5	76.0	76.2	76.4	76.9	77.0	**76.3**
M_2	19.5	19.7	19.8	19.9	20.3	20.7	**20.0**	47.7	47.3	47.7	47.8	48.0	48.0	**47.8**	73.0	73.1	73.6	74.0	74.5	74.8	**73.8**	78.0	77.9	78.2	78.6	78.7	78.7	**78.4**

ISSN: 2583-4053
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M_3	20.8	20.9	21.16	21.8	22.5	22.5	**21.6**	48.6	49.2	49.5	49.6	49.8	50.9	**49.6**	74.9	75.2	75.8	75.9	76.4	76.7	**75.8**	80.0	80.4	80.7	80.8	80.8	81.2	**80.7**
M_4	22.7	22.8	23.0	23.6	24.2	24.1	**23.4**	51.3	51.5	51.8	52.5	52.8	53.8	**52.3**	76.9	77.5	77.6	77.7	77.7	78.5	**77.7**	81.9	82.6	82.8	82.9	83.2	83.9	**82.9**
Mean	**20.1**	**20.3**	**20.6**	**21.0**	**21.5**	**21.6**	**20.8**	**47.9**	**48.4**	**48.7**	**49.0**	**49.2**	**49.8**	**48.8**	**73.2**	**73.9**	**74.3**	**74.5**	**74.8**	**75.3**	**74.3**	**78.9**	**79.2**	**79.5**	**79.7**	**79.9**	**80.2**	**79.6**

Treatments	**CD (5%)**	**CD (5%)**	**CD (5%)**	**CD (5%)**
Main	0.972	0.873	0.682	1.031
Sub	0.939	0.704	0.620	0.606
Main x Sub	1.878	1.418	1.241	1.202

Table 2: Effect of cropping system and integrated nutrient management on number of leaves in m^2 at different crop growth stages in wheat

Treatments	**At tillering stage**						**Mean**	**At blooming stage**						**Mean**	**At flowering stage**						**Mean**
	S_1	**S_2**	**S_3**	**S_4**	**S_5**	**S_6**		**S_1**	**S_2**	**S_3**	**S_4**	**S_5**	**S_6**		**S_1**	**S_2**	**S_3**	**S_4**	**S_5**	**S_6**	
M_1	1073.9	1109.4	1110.8	1110.9	1114.2	1114.8	**1105.7**	1698.6	1704.3	1706.6	1709.0	1711.6	1712.3	**1707.1**	1991.0	1995.3	1998.6	2001.7	2004.3	2006.4	**1999.6**
M_2	1117.4	1119.09	1120.0	1122.4	1123.6	1125.0	**1121.2**	1706.3	1709.6	1711.3	1712.6	1714.0	1715.6	**1711.6**	1998.0	2001.4	2004.7	2005.7	2008.3	2011.0	**2004.9**
M_3	1121.7	1123.7	1126.6	1126.8	1128.4	1130.3	**1126.3**	1713.6	1717.6	1720.3	1720.0	1722.6	1723.0	**1719.5**	2006.3	2010.6	2010.7	2013.6	2015.7	2019.0	**2012.7**
M_4	1126.1	1127.8	1129.7	1130.9	1132.2	1133.3	**1130.0**	1716.3	1720.0	1721.6	1723.7	1725.4	1726.7	**1722.3**	2012.3	2017.0	2021.0	2023.3	2024.0	2027.0	**2020.8**
Mean	**1109.8**	**1120.0**	**1121.8**	**1122.8**	**1124.6**	**1125.9**	**1120.8**	**1708.7**	**1712.9**	**1715.0**	**1716.3**	**1718.4**	**1719.4**	**1715.1**	**2001.9**	**2006.1**	**2008.8**	**2011.1**	**2013.1**	**2015.9**	**2009.5**

Treatments	**CD (5%)**	**CD (5%)**	**CD (5%)**
Main	11.4	9.19	2.78
Sub	9.63	8.99	1.25
Main x Sub	19.26	17.99	2.51

Table 3: Effect of cropping system and integrated nutrient management on number of tillers (m^2) at different crop growth stages in wheat

Treatments	**At tillering stage**						**Mean**	**At blooming stage**						**Mean**	**At flowering stage**						**Mean**
	S_1	**S_2**	**S_3**	**S_4**	**S_5**	**S_6**		**S_1**	**S_2**	**S_3**	**S_4**	**S_5**	**S_6**		**S_1**	**S_2**	**S_3**	**S_4**	**S_5**	**S_6**	
M_1	172.3	174.6	177.6	178.0	180.0	180.3	**177.1**	263.6	267.3	268.6	270.0	272.0	273.0	**269.1**	291.3	295.0	297.4	298.3	302.0	303.0	**297.8**
M_2	176.3	179.3	181.0	182.3	184.3	185.6	**181.5**	268.0	271.3	272.6	274.6	276.0	277.6	**273.4**	294.6	298.6	300.0	303.0	305.3	307.6	**301.5**
M_3	180.3	183.0	184.0	186.0	186.6	187.0	**184.5**	271.3	274.3	275.3	276.6	279.3	280.0	**276.1**	298.6	301.6	303.3	305.3	308.0	308.0	**304.1**
M_4	182.6	185.3	187.6	189.3	190.3	192.0	**187.9**	275.3	278.3	279.6	281.0	282.6	284.3	**280.2**	304.0	307.7	308.1	311.0	314.2	315.0	**310.0**
Mean	**177.9**	**180.6**	**182.6**	**183.9**	**185.3**	**186.2**	**182.7**	**269.6**	**272.8**	**274.0**	**275.6**	**277.5**	**278.7**	**274.7**	**297.1**	**300.7**	**302.2**	**304.4**	**307.4**	**308.4**	**303.4**

Treatments	**CD (5%)**	**CD (5%)**	**CD (5%)**
Main	2.320	1.825	3.572
Sub	0.956	0.878	1.131
Main x Sub	1.903	1.747	2.272

ISSN: 2583-4053
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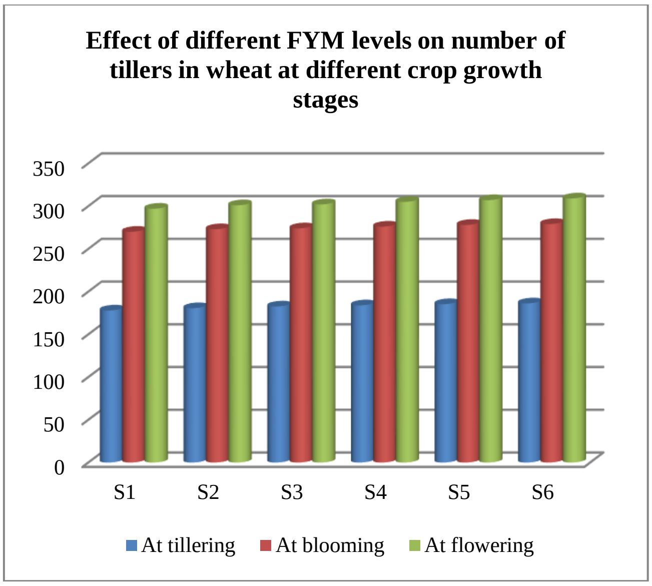
https://doi.org/10.55544/jrasb.2.2.27



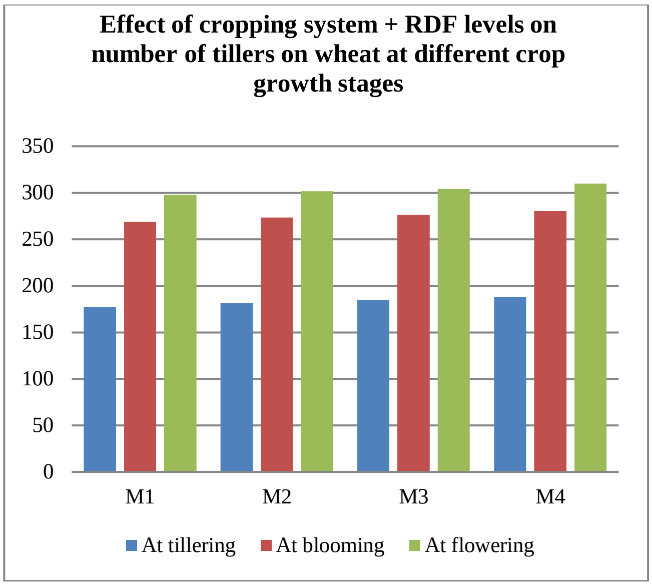


Table 4: Effect of system of wheat intensification and integrated nutrient management on dry weight (g) at different crop growth stages in wheat

Treatments	At tillering stage						Mean	At blooming stage						Mean
	S_1	S_2	S_3	S_4	S_5	S_6		S_1	S_2	S_3	S_4	S_5	S_6	
M_1	47.3	49.4	49.6	51.1	52.1	53.0	**50**	232.0	240.0	243.6	246.6	247.3	249.0	**243**
M_2	50.6	53.4	54.1	55.4	56.2	57.0	**55**	241.3	246.6	248.6	250.6	252.6	255.0	**249**
M_3	52.8	55.2	55.7	56.8	57.9	58.8	**56**	245.0	250.0	253.0	254.0	256.3	258.0	**253**
M_4	56.1	58.8	59.3	60.4	61.2	62.3	**60**	249.3	253.0	254.6	258.6	262.0	264.6	**257**
Mean	**51.7**	**54.2**	**54.7**	**55.9**	**56.9**	**57.8**	55	**241.9**	**247.4**	**250.0**	**252.5**	**254.6**	**256.7**	251

Treatments	**CD (5%)**	**CD (5%)**
Main	2.969	5.599
Sub	0.473	1.803
Main x Sub	0.956	3.606

Table 4.1: Effect of system of wheat intensification and integrated nutrient management on dry weight (g) at different crop growth stages in wheat

Treatments	At flowering stage						Mean	At maturity						Mean
	S_1	S_2	S_3	S_4	S_5	S_6		S_1	S_2	S_3	S_4	S_5	S_6	
M_1	723.6	730.3	731.3	735.3	740.3	743.0	**734**	929	937	939	946	947	951	**942**
M_2	733.6	738.6	739.6	744.6	745.0	748.0	**742**	938	945	947	953	957	962	**950**
M_3	739.0	745.0	753.3	752.3	753.3	756.3	**750**	946	954	956	963	964	970	**959**
M_4	743.6	750.3	750.6	754.0	758.6	760.6	**753**	952	959	960	967	970	977	**964**
Mean	**735.0**	**741.1**	**743.7**	**746.6**	**749.3**	**752.0**	745	**941.3**	**948.8**	**950.5**	**957.3**	**959.5**	**965.0**	954

Treatments	**CD (5%)**	**CD (5%)**
Main	2.969	5.599
Sub	0.473	1.803
Main x Sub	0.956	3.606

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https://doi.org/10.55544/jrasb.2.2.27

Increase in grain N content and protein content at higher fertility level were found by many workers Brar and Dev (1983); Chauhan *et al.* (2000); Pandey *et al*. (2006); Gupta *et al*. (2007).

Significantly higher protein content under system of wheat intensification is might be due to efficient utilization of nutrients for their overall growth.

1.4 Effect of RDF and SWI on economic return of wheat:

Application of 100% RDF under system of wheat intensification registered maximum net return (Rs.91256.41) and benefit cost ratio (2.44) as compared to rest of the treatments.

2. Effect of Farm Yard Manure (FYM) on growth, yield, quality and economic of wheat

2.1 Effect of FYM on growth and growth attributes of wheat

In general, the growth and growth attributes of wheat was significantly influenced by different levels of FYM at different crop growth stages, the result of the experiment showed that, increasing level of FYM will significantly increase the growth and growth attributes of wheat at different crop growth stages. The plant height, number of leaves, number of tillers and dry weight of wheat was increased with increased level of FYM. Application of 100 percent FYM (S_6) recorded significantly higher plant height (21.6 cm, 49.8 cm, 75.3 cm and 80.2 cm) and dry weight (57.8, 256.7, 752.0 and 965.0 g per m^2) as compared to control or 0% FYM (20.1 cm, 47.9 cm, 73.2 cm and 78.9 cm) and (51.7, 241.9, 735.0 and 941.3 g per m^2) at tillering, blooming, flowering and maturity stage. Similarly, the significant and maximum number of leaves (1125.9, 1718.4 and 2015.9) and number of tillers (186.2, 278.7 and 308.4) was registered with application of 100 percent FYM at tillering, blooming and flowering stages of wheat as compared to control or no use of FYM (1109.8, 1708.7 and 2012.3) and (177.9, 269.6 and 297.1) respectively.

Significantly higher growth and growth attributes were recorded with application of increasing level of farm yard manure this improvement might be due to slow realizable of macro and micro nutrients which have contributed for better translocation of metabolites and photosynthates and led to better growth attributes. In addition, the beneficial effect of FYM is due to its contribution in supplying additional plant nutrients, improvement of soil physical, chemical and biological process in soil. Metabolites root activities increased resulting absorption of moisture and other nutrients enhanced resulting into higher growth and growth attributes. Kumar *et al.*, (2010) [11] and Chauhan *et al.*, (2010).

2.1 Effect of FYM on yield and yield attributes of wheat

Yield and yield attributes showed positive response to 100 FYM. Among the sub treatments significantly higher spike length (11.1 cm), number of grains per spike (26.2), 1000 grain weight (34.6 g), grain yield (3553.7 kg ha^{-1}), straw yield (5935.5 kg ha^{-1}) and harvest index (37.4) were registered in S_6 due to application 100% FYM as compared to rest of the treatments.

Improvement in wheat yield and related attributes due to incorporation of FYM and RDF can be attributed to balanced carbon nitrogen ratio, more organic matter buildup, better root proliferation, sustainable nutrient availability, accelerated transport and higher concentration of plant nutrients. These might have lead to better assimilation of photosynthetates and their efficient translocation from source to sink, resulting in an improvement in overall yield besides having very fruitful effect on soil properties (Ajaz *et al.*2013).

Table 5: Effect of cropping system and integrated nutrient management on yield component of wheat

Treatments	Spike length (cm)						Mean	Number of grain per spike						Mean	1000 grain weight (g)						Mean
	S_1	S_2	S_3	S_4	S_5	S_6		S_1	S_2	S_3	S_4	S_5	S_6		S_1	S_2	S_3	S_4	S_5	S_6	
M_1	10.17	10.23	10.24	10.30	10.31	10.33	**10.3**	18.67	19.99	20.12	20.42	20.65	20.86	**20.1**	32.88	33.14	33.21	33.29	33.34	33.40	**33.2**
M_2	10.24	10.31	10.32	10.37	10.38	10.45	**10.3**	19.03	20.52	20.74	21.49	21.61	22.14	**20.9**	33.13	33.29	33.34	33.45	34.19	33.61	**33.5**
M_3	10.47	10.72	10.77	11.00	11.18	11.29	**10.9**	20.04	23.67	24.66	28.40	30.29	31.83	**26.5**	33.79	34.15	34.32	34.53	34.86	35.14	**34.5**
M_4	11.39	11.64	11.69	11.81	12.08	12.15	**11.8**	22.12	24.58	26.76	29.43	31.33	29.83	**27.3**	34.49	35.04	35.22	35.57	35.83	36.05	**35.4**
Mean	**10.6**	**10.7**	**10.8**	**10.9**	**11.0**	**11.1**	**10.8**	**20.0**	**22.2**	**23.1**	**24.9**	**26.0**	**26.2**	**23.7**	**33.6**	**33.9**	**34.0**	**34.2**	**34.6**	**34.6**	**34.1**

Treatments	CD (5%)	CD (5%)	CD (5%)
Main	0.259	1.718	0.262
Sub	0.035	1.247	0.211
Main x Sub	0.071	2.494	0.433

Journal for Research in Applied Sciences and Biotechnology
www.jrasb.com

ISSN: 2583-4053
Volume-2 Issue-2 || April 2023 || PP. 182-192
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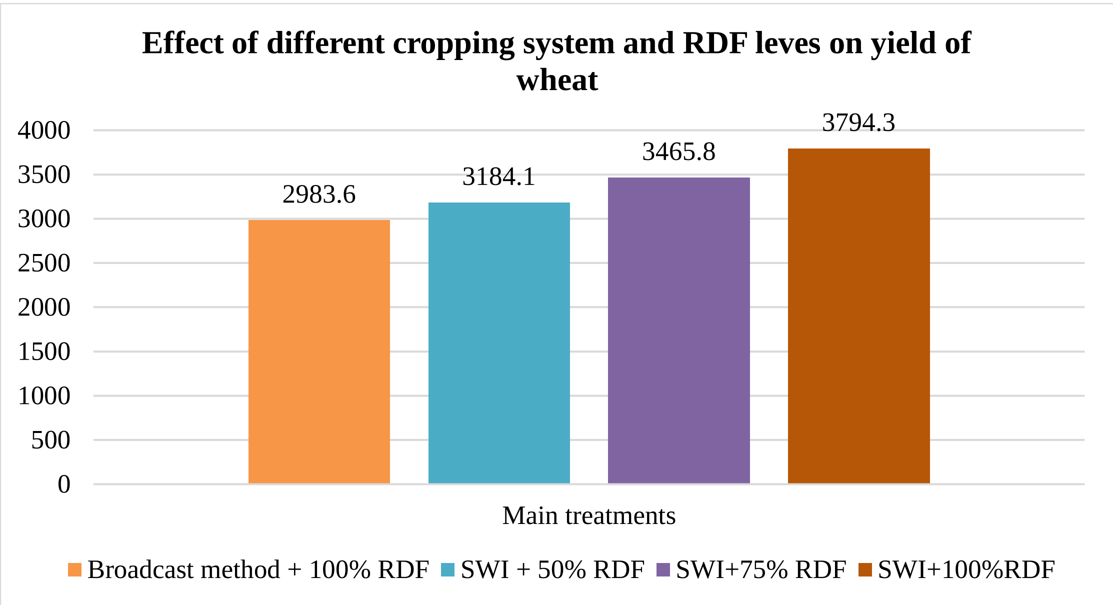
Table 6: Effect of cropping system and integrated nutrient management on yield component of wheat

Treatments	Grain yield (kg ha^{-1})						Mean	Straw yield (kg ha^{-1})						Mean	Harvest index (%)						Mean
	S_1	S_2	S_3	S_4	S_5	S_6		S_1	S_2	S_3	S_4	S_5	S_6		S_1	S_2	S_3	S_4	S_5	S_6	
M_1	2737.0	2896.7	2953.3	3030.4	3120.6	3163.3	**2983.6**	5128.0	5253.6	5283.3	5330.3	5377.0	5413.4	**5297.6**	34.79	35.54	35.85	36.24	36.72	36.88	**36.0**
M_2	2937.0	3119.3	3178.3	3238.6	3283.0	3348.3	**3184.1**	5329.3	5476.7	5544.0	5640.0	5670.3	5733.3	**5565.6**	35.53	36.29	36.44	36.48	36.67	36.87	**36.4**
M_3	3176.6	3393.0	3462.3	3531.0	3588.6	3643.3	**3465.8**	5406.6	5656.7	5802.7	5920.0	6040.0	6145.3	**5828.6**	37.01	37.49	37.37	37.37	37.27	37.21	**37.3**
M_4	3392.6	3707.3	3772.7	3878.6	3954.7	4060.0	**3794.3**	5629.7	5905.0	6049.0	6210.3	6336.6	6450.0	**6096.8**	37.60	38.56	38.41	38.44	38.42	38.62	**38.3**
Mean	**3060.8**	**3279.1**	**3341.7**	**3419.7**	**3486.7**	**3553.7**	**3356.9**	**5373.4**	**5573.0**	**5669.8**	**5775.2**	**5856.0**	**5935.5**	**5697.1**	**36.2**	**37.0**	**37.0**	**37.1**	**37.3**	**37.4**	**37.0**

Treatments	**CD (5%)**	**CD (5%)**	**CD (5%)**
Main	104.870	119.744	0.407
Sub	33.375	53.912	0.245
Main x Sub	66.740	107.825	0.481

Table 7: Effect of cropping system and integrated nutrient management on protein content of wheat

Treatments	Protein content (%)						Mean
	S_1	S_2	S_3	S_4	S_5	S_6	
M_1	9.93	10.01	10.23	10.27	10.30	10.35	10.18
M_2	10.25	10.35	10.37	10.44	10.50	10.52	10.41
M_3	10.45	10.58	10.66	10.72	10.80	10.86	10.68
M_4	10.53	10.70	10.79	10.85	10.95	11.03	10.81
Mean	10.29	10.41	10.51	10.57	10.64	10.69	10.52



2.3 Effect of FYM on quality of wheat

Application of 100 percent farm yard manure recorded significant and maximum protein content (10.69%) as compared to rest of the treatments. While, the minimum protein content (10.29%) was recorded in S_1 due to application of 0% FYM.

The higher protein content with application of higher dose of FYM is might be due to better availability of nutrients under adequate supply of available nutrients by FYM application. Pathan *et al.*, (2010) and Sisodia *et al.*, (2010).

ISSN: 2583-4053
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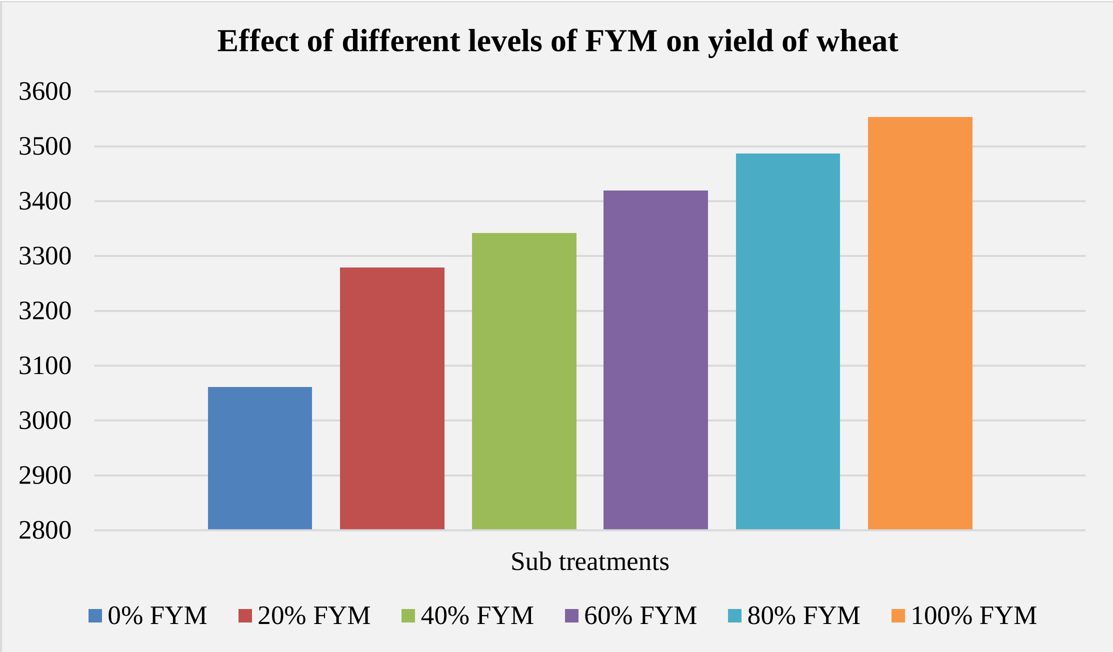
2.4 Effect of FYM on economic of wheat

Different levels of FYM influenced total cost of cultivation, gross return, net return and benefit cost ratio. Application of zero percent FYM recorded the lowest total cost of cultivation (Rs.52709.73) followed by S_2 (Rs.57509.73), S_3 (Rs. 62309.73), S_4 (Rs. 67109.73), S_5 (Rs.71909.73) and S_6 (Rs. 76709.7S) respectively. Similarly, Application of 100 percent FYM registered higher gross return (Rs.148198.7) as compared to rest of the treatments. However, the lowest gross return (Rs. 130255.0) was recorded in S_1 due to application of 0% FYM. In addition, application of 20 percent FYM recorded maximum net return (Rs.80197.36) as compared to rest of the treatments.



However, the lowest net return (Rs. 71489.03) was recorded in S_6 due to application of 100% FYM. Different levels of farm yard manure influenced the B: C ratio of wheat, among the sub treatments; treatment S_1 with application of 0 percent FYM registered maximum B: C ratio (2.48) as compared to rest of the treatments.

3. Effect of cropping system, RDF and FYM on growth, yield, quality and economic return of wheat:

1. The interaction between combinations of NPK level, system of sowing and FYM were found significant with respect to almost growth and growth attributes. The application of 100% RDF under system of wheat intensification along with 100% FYM exhibited the maximum growth and growth attributes at different crop growth stages.
2. The interaction between combinations of NPK levels, system of sowing and FYM influenced yield and yield attributes of wheat. The maximum values of these parameters were observed with application of 100 percent RDF + 100 percent FYM under system of wheat intensification as compared to rest of the treatments.
3. The maximum net return (Rs. 94363.63 ha^{-1}) were recorded in treatment received 100% RDF+20% FYM under system of wheat intensification as compared to rest of the treatments.

Table 8: Effect of cropping system and integrated nutrient management on total cost of cultivation and gross return of wheat

Treatments	Total cost of cultivation (Rs. ha^{-1})						Mean	Gross return (Rs. ha^{-1})						Mean
	S_1	S_2	S_3	S_4	S_5	S_6		S_1	S_2	S_3	S_4	S_5	S_6	
M_1	57202.70	62002.70	66802.70	71602.70	76402.70	81202.70	**69202.7**	119705.00	124953.33	126666.67	129061.67	131786.67	133216.67	**127565.00**
M_2	49862.70	54662.70	59462.70	64262.70	69062.70	73862.70	**61862.7**	126718.33	132750.00	134898.33	137366.67	138778.33	141041.67	**135258.89**
M_3	51203.80	56003.80	60803.80	65603.80	70403.80	75203.80	**63203.8**	133483.33	141391.67	144585.00	147475.00	150116.67	152536.67	**144931.39**
M_4	52569.70	57369.70	62169.70	66969.70	71769.70	76569.70	**64569.7**	141113.33	151733.33	154806.67	159070.00	162233.33	166000.00	**155826.11**
Mean	**52709.73**	**57509.73**	**62309.73**	**67109.73**	**71909.73**	**76709.73**	**64709.7**	**130255.00**	**137707.08**	**140239.17**	**143243.34**	**145728.75**	**148198.75**	**140895.3**

ISSN: 2583-4053
Volume-2 Issue-2 || April 2023 || PP. 182-192
https://doi.org/10.55544/jrasb.2.2.27

Table 9: Effect of cropping system and integrated nutrient management on net return and benefit cost ratio of wheat

Treatments	Net return (Rs. ha^{-1})						Mean	Benefit cost ratio						Mean
	S_1	S_2	S_3	S_4	S_5	S_6		S_1	S_2	S_3	S_4	S_5	S_6	
M_1	62502.30	62950.63	59863.97	57458.97	55383.97	52013.97	**58362.30**	2.09	2.02	1.90	1.80	1.72	1.64	**1.86**
M_2	76855.63	78087.30	75435.63	73103.97	69715.63	67178.97	**73396.19**	2.54	2.43	2.27	2.14	2.01	1.91	**2.22**
M_3	82279.53	85387.87	83781.20	81871.20	79712.87	77332.87	**81727.59**	2.61	2.52	2.38	2.25	2.13	2.03	**2.32**
M_4	88543.63	94363.63	92636.97	92100.30	90463.63	89430.30	**91256.41**	2.68	2.64	2.49	2.38	2.26	2.17	**2.44**
Mean	**77545.27**	**80197.36**	**77929.44**	**76133.61**	**73819.03**	**71489.03**	**76185.62**	**2.48**	**2.40**	**2.26**	**2.14**	**2.03**	**1.94**	**2.21**

IV. CONCLUSION

On the basis of economic analysis it is concluded that wheat cv. 'Mazar 99' sown under system of wheat intensification treated by 100% recommended dose of fertilizer (120-60-60 kg NPK/ha) accompanied with 20% N through FYM proved to be the most remunerative dose which will increase the grain yield of wheat by 33 percent as compared to M_1S_1 due to application of 100% RDF + 0% FYM under broadcast method of sowing. However, SWI will increase the net return by 36 percent as compared to broadcast method of sowing.

RESEARCH CATEGORY

System of Wheat Intensification (SWI), Recommended Dose of Fertilizer (RDF), Farm Yard Manure (FYM), Growth, Yield, Quality, Economic, Wheat, Gardiz, Paktia, Afghanistan.

ACKNOWLEDGEMENT / FUNDING

Authors are thankful to Higher Education Development Program (HEDP), Ministry of Higher Education (MoHE), Islamic Republic of Afghanistan and Paktia University for providing the fund and opportunity for the experiment.

UNIVERSITY

Paktia University, Gardiz, Paktia, Afghanistan

RESEARCH PROJECT NAME OR NUMBER

Individual Research Project, Higher Education Development Project (HEDP), Ministry of Higher Education (MoHE), Islamic Republic of Afghanistan.

AUTHOR STATEMENT

The authors read, reviewed, agreed and approved the final manuscript.

CONFLICT OF INTEREST

None declared

ETHICAL APPROVAL

This article does not contain any studies with human participants or animals performed by any of the authors.

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ISSN: 2583-4053
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