APPLICATION Of ORGANIC AND INORGANIC AMENDMENTS: A STRATEGY FOR IMPROVING WHEAT PRODUCTIVITY.

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Abstract- Final yield of wheat crop is directly associated with the application of both organic and inorganic fertilizers and is considered to be a key factor in cereal-based cropping system. In order to explore the effect of organic and inorganic fertilizers the current study was conducted at Palatoo Research Farm, the University of Agriculture, Amir Muhammad Khan campus Mardan during 2015-2016. The experiment was carried out in randomized complete block design with 12 treatments. The treatments consisted of T_1=Control, T_2=urea (U), T_3 = Farmyard manure (FYM), T_4= Poultry manure (PM) T_5= Sheep manure (SM), T_6= FYM + U, T_7= PM + U, T8= SM + U, T9= FYM + PM + U, T10= FYM + SM + U, T_{11}= PM + SM + U, T_{12}= FYM + SM + PM + U. In order to apply 120 kg N, organic and inorganic sources were combined in different rations. Wheat cultivar Galaxy "2013" was sown in the month of Dec-2015 at the seed rate of 120 kg ha^{-1}. The results of the study indicated that Organic and inorganic amendments and their different combinations significantly affected all parameters. Sole application urea(U) performed better which improved tiller m^{-2}(267), leaf area index (2.40), days to maturity (142), grains $spike^{-1}$(53), thousand grains weight (37g), grain yield (2376 kg ha^{-1}). Likewise, higher number of tiller m^{-2}(283), grains $spike^{-1}$(56), leaf area index (2.62), thousand grain weight (38.8 g), grain yield (2471 kg ha^{-1}) with the combinations of organic and inorganic amendments applied in different ratios. In case of organic manures, poultry manure (PM) produced higher tillers m^{-2}(256), grains $spike^{-1}$ (48), leaf area index (2.25), thousand grains weight (35.9g), grain yield (2301 kg ha^{-1}) when applied alone. It is concluded that sole application of PM or integrated application of PM + U performed best among all organic and inorganic amendments used alone and in combinations, therefore it is recommended for obtaining higher grain yield of wheat under rainfed condition of Mardan.

Key words: Wheat, Organic amendments, Inorganic amendments, grain yield,

INTRODUCTION

Due to the rapid increase in the prices of inorganic fertilizers its purchase and availability is a serious and alarming issue. Wheat (Triticum aestivum L.) is the world principal food crop. It grades first amongst the cereal crops in Pakistan and approximately occupies 66% of the annual cropped area (Khalil and Jan, 2002). Wheat is an essential steady food and most commonly grown cereal of the world. The reliance of large residents on this crop and increment population of the world needs considerable further wheat to be produced (Rana et al., 2013).

Nitrogen is the mineral nutrient pre requisite in the premier concentration by plants (Taiz & Zeiger, 2006), whereas the quantity of nitrogen available to the plant generally is inadequate (Elser et al., 2007). Nitrogen makes cereal crops more nutritive by stimulating protein contents in grains and deficient nitrogen results in reducing tillering, disturbing normal growth and cell division (Khalil and Jan, 2002). Plant roots take up N chiefly in the form of nitrate (NO_3^-) and ammonium (NH_4^+), but organic nitrogen in the form of amino acids (Maathuis, 2009). Nitrogen application at tillering stage had greater uptake than late application (Iqbal et al., 2005). Nitrogen accrues in the wheat crop with greater accrual rates during the major growth period than during grain filling (Baresel et al., 2008).

After irrigation, nitrogenous fertilizer is the second most significant input for wheat crop growth and development (Lenka et al., 2009). Improved application rate of nitrogen fertilizer is considered to be a primary resources of improving wheat grain yield and protein content (Haileet al., 2012). Inorganic N fertilizers include high level of free available nutrients and mostly dissolving in water for releasing nutrients and its uniform application to the plant (Doberman and Fairhurst, 2000). To fulfill the demand of food, inorganic fertilizers play a key role in promoting crop productivity (Ahmad et al., 2013). Khalil and Jan (2002) described that nitrogen application to crop increasing leaf area and tillering, root development, plant height, biological and grain yield.

Manures are natural accruing material derived from animal and plant residues and o considered as an important source of macro and micronutrients that increase crop yield. Due to greater rates of mineral fertilizers, growers in Pakistan can easily succeed to arrange manures in their farms and to lay them in fields (Khalid et al., 2011). To use of decomposable organic residues (David et al., 2005), combination of synthetic and organic N fertilizer management are believed to improve agricultural productivity in a sustainable way in arid and semi arid areas (Torbert et al., 2001). In general, the use of organic manures and compost enhances soil organic carbon more than application of the same amount of nutrients as inorganic fertilizers (Gregorich et al., 2001). Organic manures containing poultry manure, farmyard manure and sheep manure and might be used as a in place of the chemicalfertlizersfor crop production. Poultry manure and sheep manure are excellent organic

fertilizers; contain high NPK and other crucial nutrients (Deksissa et al., 2008).

It is not promising to attain greater crop yield by consuming only organic manure (Bair, 2000). Manures are contain little amount of plant nutrientsandthey have a sluggish performing nature, sole application of organic manuremay fail to incline the high nutritional requirementof crops (Hossain et al., 2002). Shah et al. (2010) also reported that organic manure required high energy for its application to field, while continues uses of chemical fertilizers degrading soil health and along with rapid nitrification causes pollution (Subbarao et al., 2009). However, organic manure with mineral fertilizers looks to be a possible solution (Prabu et al., 2003). There is a synergetic relation among organic and inorganic sources of nitrogen for crop yield (Yang et al., 2007).The appropriate integration of organic and mineral fertilizers together has superior effect on crop growth, development and yield components of wheat than alone (Manna et al., 2005). Increase in grain yield, bio-mass, tillers populations, grain size and weight has been reported by (Sing and Agarwal, 2001) through the combined application of organic manure and inorganic fertilizer nitrogen. Application of combined nutrients improved bulk density, pore space, organic carbon and particle density of the soil and make the soil favorable for crop production.

Keeping in view there valid findings and evidences, a field experiment was led with objectives to compare the influence of different organic manures and inorganic (urea) fertilizer on the wheat productivity and to determine the dominant combination of organic and inorganic fertilizers for wheat yield enhancement in agro climatic condition of Mardan.

MATERIALS AND METHODS

The experiment entitled "Improving wheat productivity through organic and inorganic amendments in agro climatic condition of Mardan" was carried out at Palatoo Research Farm, Amir Muhammad Khan campus Mardan during 2015-16. Experimental site lies at latitude 34° 11′ 54″ North, longitude 72° 2′ 45″ East at elevation of 285 m above sea level and the climatic conditions are semi-arid to arid.

The treatments comprised of T_1= Control, T_2 = urea (U), T_3 = Farmyard manure (FYM), T_4 = Poultry manure (PM) T_5 = Sheep manure (SM), T_6 = FYM + U, T_7 = PM + U, T8 = SM + U, T9 = FYM + PM + U, T10 = FYM + SM + U, T_{11}= PM + SM + U, T_{12} = FYM + SM + PM + U laid out in randomized complete block designed with four replications. The fertilizers were used alone and in combination in equal amount to supply N of 120 kg ha^{-1} in various ratios (100, 50, 33, 25). Wheat cultivar Galaxy "2013" was sown in month of Dec-2015 at the seed rate of 120 kg ha^{-1}. Organic manures were also subject to nutrients analysis, the analytical results revealed that FYM, PM and SM contained 0.52, 1.80, 1.20% N, 0.36, 1.62, 0.58% P_2O_5 and 0.66, 0.94, 0.40% K_2O, respectively. Manures were applied before sowing and mixed using hand hoe, while urea applied in two equal split doses, half at the time of sowing and remaining half after first rainfall. Single super phosphate was also used as phosphorus source at the rate of 40 kg P ha^{-1}.

The plot size was 3 m x 3 m, the row length was 3 meters and row to row distance of 30 cm was maintained. The field ploughed twice and planking was carried out to prepare fine tilth. The field was irrigated only once before sowing and no further irrigation applied till maturity (rainfed condition). All the cultural operations applied uniformly to all experimental units as needed.

Least significant difference test (LSD) was used for significance at 0.05 level of probability according to (Jan *et al.*, 2009). Planned Mean comparison was also carried out to explain the different treatments effect and to make the table more descriptive.

RESULTS

The primary yielding component i.e. tillers m^{-2} of wheat significantly influenced by FYM, PM, SM, and urea whether used alone or in combination. The tillers 283 m^{-2} produced in plots where urea was applied in combination with PM statistically at par with FYM +U, FYM+PM+U, and FYM+SM+PM+U in combinations which produced 266, 268, 267 and 266 tillers m^{-2}, respectively. While the sole application of urea produced 267 tillers m^{-2} and 223 tillers m^{-2} from control. The comparison of organic vs inorganic revealed inorganic superior with 262 tillers m^{-2} to organic manure sources 247 tillers m^{-2}. Among the organic manures, sole application of PM produced 256 tillers m^{-2} than sole application of SM 236 tillers m^{-2}. The combination of organic + inorganic showed PM+U produced more tillers m^{-2} 283 than SM+U 262 tillers m^{-2}.

Leaf area index

Mean of the treatments showed that FYM, PM, SM, and U used alone and in combination significantly affected leaf area index of wheat (Table 1). Means value showed that maximum leaf area index (2.6) was recorded in plots which received PM + Uwas statistically at par with plots received FYM + U (2.4). Control plots resulted in minimum (1.8) LAI. Comparison among planned means revealed that control vs rest, organic vs inorganic, PM+U vs SM+U and PM vs SM significantly affected the leaf area index of wheat. Greater LAI (2.3) was resulted in rest plots while lower in control (1.8) plots. Amongst the organic and organic fertilizers, sole inorganic amendments more improved leaf area index (2.4) as compare to sole organic manure (2.1). In case of PM+U vs SM+U, greater LAI (2.6) was noted in PM + U plots in comparison with SM+ U (2.3) plots. The application of PM produced higher (2.3) leaf area index than SM (2.0) followed by FYM (2.2) plots.

Days to maturity

Data associated to days to maturitygiven in Table 1. Mean values were statistically analyzed and indicated that FYM, PM, SM, and U used alone and in combination significantly influenced days to maturity of wheat. Maximum (142) days to

maturity was recorded in plots fertilized with PM +U or urea alone which was followed by plots fertilized with FYM + U and FYM+PM + U which delayed maturity (140, 140 days), respectively. Minimum days to maturity (137) recorded in control plot.planned mean comparison indicated that control vs rest, organic vs inorganic and FYM + PM + SM + U vs U significantly affected days to maturity. Maximum days to maturity (140) was found in rest plots as compare to control (137) plots. Maturity was delayed to 142 days in plots with inorganic fertilizer as compare to 139 days in plots only organic manure applied. Among FYM + PM + SM + U vs U, higher days to maturity (142) was recorded with urea application while minimum days to maturity (139) was recorded in plots which received FYM + PM + SM + U. All other mean comparisons did not significantly affect days to maturity of wheat.

Grains spike^{-1}

Organic and inorganic amendments showed a profound effect on grains spike^{-1} of wheat. Highest number of grainsspike^{-1} (56) were recorded inPM + U plots followed by plots amended with FYM + U (53), FYM+PM + U (52) in combination but, plots applied with urea alone also produced (53) grains spike^{-1}.Control plots produced lowest number of grains spike^{-1}(41) (Table 1).The possible reasons for that might be instantly availability of mineral fertilizer and mineralization of organic manures all over the growing period which provided gradual N supply resulted in maximum grains spike^{-1}.These results are supported by Iqbal et al. (2002), and Arif et al. (2006), who reported clear increase in number of grain spike^{-1} of wheat by combined application of organic manure and mineral fertilizer.The planned mean comparison for grains spike^{-1} among control vs rest, organic vs inorganic, PM+U vs SM+U and PM vs SM were found significant. Maximum grains spike^{-1} was found for the rest (50) of plots as compared to control plots (41). Grains spike^{-1} was higher in plots having the mixture of PM + U (56), while it was lower in plots having mixture of SM + U (51). Urea applied alone also more improved grains spike^{-1}(53) than organic manure (47) applied alone. Among the organic manures, sole PM plots produced greater number of grains spike^{-1}(48)than SM (44).

Thousand grains weight (g)

The weight of grain is an essential yield component and made major impact towards grain yield of wheat. Data concerning to thousand grain weight (g) are given in Table 1. Statistically analysis mean values exposed that FYM, PM, SM, and U used alone and in combination significantly affected thousand grain weights (g) of wheat. Maximum thousand grain weights were absorbed from PM + U 38.8 g plots that was at par with plots fertilized with urea alone and FYM + U which produced 37 g and 36.9 g, respectively. The minimum thousand grain weights observed in unfertilized 28.2 g plots followed by sole application of SM and FYM which produced 33.4 g and 34.1 g, respectively. The increase in thousand grain weight was mostly due to the balanced source of nutrients from both urea and poultry manure during the grain filling and development stage. These results are similar to the findings of Khaliq et al. (2004); Shah et al.(2010) who noted that organic and inorganic amendments provides comfort availability of N and other soil nutrients at grain filling and development stages thus resulted in proper filled grains. The combined application of PM + U produced higher thousand grain weight than combined application of SM + U. The planned mean comparison for thousand grain weights among different treatments indicated that control vs rest, organic vs inorganic, PM + U vs SM + U and PM vs SM showed significant effect on thousand grain weight of wheat. Higher thousand grain weights were obtained in rest (36 g) treatments as compared to control (28.2 g) treatment. The sole application of inorganic fertilizer gave higher thousand grain weights (37 g) in comparison with organic manure (34.4 g). The combined application of PM + U produced higher thousand grain weights (38.8 g) than combined application of SM + U (36.3 g). Among the organic manure, maximum thousand grain weights (35.9 g) was observed in PM plots, while minimum in SM (33.4 g) plots.

Grain yield (kg ha^{-1})

Grain yield is the finale result of several morphological and physiological processes happening throughout the growth and development of crop. Data concerning to grain yield (kg ha^{-1}) is shown in Table 1. Maximum grain yield (2471 kg ha^{-1}) observed in plots fertilized with PM + urea that was statistically at par with plots fertilized with urea, FYM + urea and FYM + SM + PM + U which produced 2376, 2364 and 2348 grain yield kg ha^{-1}, respectively. Minimum grain yield (1920 kg ha^{-1}) observed in unfertilized plots (control). The planned mean comparison showed that control vs rest, organic vs inorganic, PM + U vs SM + U and PM vs SM significantly affected grain yield of wheat. Rest (treated) plots produced higher grain yield (2299 kg ha^{-1}) than control plots (1920 kg ha^{-1}). Application of sole urea produced more grain yield (2376 kg ha^{-1}) as compared to organic manures (2181 kg ha^{-1}) applied alone. Grain yield was higher when combination of PM + U (2471 kg ha^{-1}) used and lower with the SM + U (2281 kg ha^{-1}).The treatment received N 33:67 in ratio of (PM + SM + U, PM + FYM and SM + FYM +U) had lower grain yield. While the combination of 50:50 (PM + U or FYM + U) produced more grain yield. The combination of 75:25 (FYM + PM + SM+ U) also produced statistically at par production with 50:50 ratios. Among organic sources, maximum grain yield (2301 kg ha^{-1}) produced with application of PM, but sole application of SM did not improve the grain yield (2059 kg ha^{-1}) as compared to PM. The other mean comparisons did not show any significant variation for grain yield of wheat.

Table1. Tillers m^{-2}, LAI, days to maturity, Grains $spike^{-1}$, thousand grain weight (g) and grain yield (kg ha^{-1}) of wheat as affected by organic and inorganic amendments and their different combinations.

Treatment	Tillers m^{-2}	LAI	Days to maturity	Grains $spike^{-1}$	Thousand grains weight(g)	Grain yield (kg ha^{-1})
T_1	223 d	1.8 f	137 c	41 g	28.2 e	1920 e
T_2	267 ab	2.4 b	142 a	53 abc	37.0 ab	2376 ab
T_3	250 bc	2.2 de	139 bc	47 ef	34.1 cd	2183 cd
T_4	256 b	2.3 bcd	139 bc	48 de	35.9 bc	2301 bc
T_5	236 cd	2.0 ef	139 bc	44 fg	33.4 d	2059 d
T_6	268 ab	2.4 ab	140 ab	53 ab	36.9 ab	2364 ab
T_7	283 a	2.6 a	142 a	56 a	38.8 a	2471 a
T_8	262 b	2.3 bcd	140 ab	51 bcde	36.3 b	2281 bc
T_9	267 ab	2.4 bc	140 ab	52 bcd	36.6 b	2310 bc
T_{10}	259 b	2.2 cd	139 bc	49 cde	35.8 bc	2324 b
T_{11}	265 ab	2.3 bcd	140 ab	50 bcde	36.0 b	2277 bc
T_{12}	266 ab	2.3 bcd	139 bc	49 cde	35.9 bc	2348 ab
LSD (0.05)	18.85	0.201	2.07	3.88	1.94	127.4

Mean values followed by different letter are significantly different using LSD test at 0.05 level of probability.

Where: T1= Control, T_2 = urea (U), T_3 = farmyard manure (FYM), T_4 = poultry manure (PM) T_5 = sheep manure (SM), T_6 = FYM + U, T_7 = PM + U, T8 = SM + U, T9 = FYM + PM + U, T10 = FYM + SM + U, T_{11}= PM + SM + U, T_{12} = FYM + SM + PM + U

Table 2: Planned mean comparison of tillers m^{-2}, LAI, days to maturity, grains $spike^{-1}$, thousand grain weight (g) and grain yield (kg ha^{-1}) of wheat as affected by organic and inorganic amendments and their different combinations.

Treatment	Tillers m^{-2}		LAI		Days to maturity		Grains $spike^{-1}$		1000 grains weight(g)		Grain yield kg ha^{-1})	
	value	Sig	Value	Sig	value	sig	value	sig	value	sig	Value	Sig
Control vs Rest	223 262	*	1.8 2.3	*	137	*	41 50	*	28.2 36	*	1920 2299	*
Organic vs inorganic	247 267	*	2.1 2.4	*	139	*	47 53	*	34.4 37	*	2181 2376	*
PM+U vs FYM+U	283 268	Ns	2.6 2.4	ns	142	ns	56 53	ns	38.8 36.9	ns	2471 2364	ns
PM+U vs SM+U	283 262	*	2.6 2.3	*	142	ns	56 51	*	38.8 36.3	*	2471 2281	*
FYM vs PM	250 256	Ns	2.2 2.3	ns	139	ns	47 48	ns	34.1 35.9	ns	2183 2301	ns
PM vs SM	256 236	*	2.3 2	*	139	ns	48 44	*	35.9 33.4	*	2301 2059	*
FYM+PM+U vs FYM+SM+U	267 259	Ns	2.4 2.2	ns	140	ns	52 49	ns	36.6 35.8	ns	2310 2324	ns
FYM+SM+U vs PM+SM+U	259 265	Ns	2.2 2.3	ns	139	ns	49 50	ns	35.8 36	ns	2324 2277	ns
FYM+PM+SM+U vs U	266 267	Ns	2.3 2.4	ns	139	*	49 53	ns	35.9 37	ns	2348 2376	ns

Where:* = Significant at 0.05 level,ns = non-significant.

Discussions

Tillers m^{-2}

The primary yielding component i.e. tillers m^{-2} of wheat significantly influenced by FYM, PM, SM, and urea whether

used alone or in combination. Among the organic manures, sole application of PM produce tillers m^{-2} than sole application of SM tillers m^{-2}. The combination of organic + inorganic showed PM+U produced more tillers m^{-2} 283 than SM+U tillers m^{-2}. According to Khan et al. (2016) and Dixit and Gupta (2000) application of different organic manure alone and in combination with mineral nitrogen has positively affected the number of tillers m^{-2}. The increase in tillers m^{-2} with PM and PM + U might be due more net mineralization at initial growing stage which facilitated the tillering ability of wheat crop, as mentioned by Eneji et al. (2002) and Ali Zadeh et al. (2012). Similar observation noted by Kundu et al. (2007) increased tillers m^{-2} in treated plots might be due to the high soil organic matter improving soil structure and maximizing microbial activities.

Leaf area index

Mean of the treatments showed that FYM, PM, SM, and U used alone and in combination significantly affected leaf area index of wheat. Means value showed that maximum leaf area index was recorded in plots which received PM + Uwas statistically at par with plots received FYM + U. Control plots resulted in minimum LAI. Comparison among planned means revealed that control vs rest, organic vs inorganic, PM+U vs SM+U and PM vs SM significantly affected the leaf area index of wheat. Greater LAI was resulted in rest plots while lower in control plots. Greater LAI might be the result of more leaf area, more tillers m^{-2} and development of leaves due to more vegetative growth, comparable results were also found by Oscar and Tollenaar (2006) who reported that the increase in LAI is caused by increased in number of tillers and in size of successive leaves due to supply of nitrogen. These results also supported by Khan et al. (2016) who reported that higher leaf area index was in treated plots and low in control plots due to more leaf area and more vegetative growth.

Days to maturity

Data associated to days to maturity given in Table 1. Mean values were statistically analyzed and indicated that FYM, PM, SM, and U used alone and in combination significantly influenced days to maturity of wheat. Maximum days to maturity was recorded in plots fertilized with PM +U or urea alone which was followed by plots fertilized with FYM + U and FYM+PM + U which delayed maturity, respectively. Minimum days to maturity recorded in control plot. planned mean comparison indicated that control vs rest, organic vs inorganic and FYM + PM + SM + U vs U significantly affected days to maturity. Maximum days to maturity was found in rest plots as compare to control plots. More, days to maturity in treated plots may be due to superior vegetative growth and leaf area because of organic and in organic fertilizers. Same results also reported by Iqtidar et al. (2006); Khan et al. (2013) and Deldon (2001), who reported that increase in days to maturity may be endorsed to the more leaf area duration, vegetative growth and greater light use efficiency. Maturity was delayed in plots where inorganic fertilizer was applied as compare to plots where only organic manure applied. There was no statistical difference among the organic manures in respect to days to maturity. These results are also confirmed by Rehman et al. (2010) who described that organic manure did not show significant importance on days to maturity of wheat crop.

Grains spike^{-1}

Organic and inorganic amendments showed a profound effect on grains spike^{-1} of wheat. Highest number of grainsspike^{-1} were recorded inPM + U plots followed by plots amended with FYM + U, FYM+PM + U in combination but, plots applied with urea alone also produced more grains spike^{-1}.Control plots produced lowest number of grains spike^{-1} (Table 1).The possible reasons for that might be instantly availability of mineral fertilizer and mineralization of organic manures all over the growing period which provided gradual N supply resulted in maximum grains spike^{-1}.These results are supported by Iqbal et al. (2002), and Arif et al. (2006), who reported clear increase in number of grain spike^{-1} of wheat by combined application of organic manure and mineral fertilizer.The planned mean comparison for grains spike^{-1} among control vs rest, organic vs inorganic, PM+U vs SM+U and PM vs SM were found significant. Maximum grains spike^{-1} was found for the rest of plots as compared to control plots. This enhanced grains number could be associated with enhanced soil physiochemical properties and organic matter decomposition that might have increased N availability and their effective translocation to spike. These results are in agreement with Farhad et al. (2009) and Shah et al. (2010).Poultry manure was superior among the organic manures and produced more grains spike^{-1} than SM. These higher numbers of grains spike^{-1} in PM plots may be due to its low C/N ratio. Similar results have been found by Amanullah and Hidayatullah (2016) they stated that increased in yield components after the application of poultry manure were attributed to its low C/N ratio.

Thousand grains weight (g)

The weight of grain is an essential yield component and made major impact towards grain yield of wheat. Data concerning to thousand grain weight (g) are given in Table 1. Statistically analysis mean values exposed that FYM, PM, SM, and U used alone and in combination significantly affected thousand grain weights (g) of wheat. Maximum thousand grain weights were absorbed from PM + U plots that was at par with plots fertilized with urea alone and FYM + U which produced and , respectively. The minimum thousand grain weights observed in unfertilized plots followed by sole application of SM and FYM which produced and , respectively. The increase in thousand grain weight was mostly due to the balanced source of nutrients from both urea and poultry manure during the grain filling and development stage. These results are similar to the findings of Khaliq et al. (2004); Shah et al.(2010) who noted that organic and inorganic amendments provides comfort availability of N and other soil nutrients at grain filling and development stages thus resulted in proper filled grains. The increase and decrease in 100-grain weight of wheat in different treatments may be a resulted of more or less availability of sufficient amount of nutrients at the critical growth stages. Similar results were also

documented by Mohsin et al. (2012). These finding confirmed by Amanullah and Hidayatullah. (2016), who reported that 1000-grain weight was heavier when using the mixtures of urea and poultry manure, and was lower when using urea and other manure. Rest plots and application of sole urea produced heavier 1000-grain weight than control and pure organic manure, respectively. Iqbal et al.(2002) also reported that increased in 1000-grain weight may be due to better nutrient availability and uptake by plants.

Grain yield (kg ha^{-1})

Grain yield is the finale result of several morphological and physiological processes happening throughout the growth and development of crop. Data concerning to grain yield (kg ha^{-1}) is shown in Table 1. Maximum grain yield observed in plots fertilized with PM + urea that was statistically at par with plots fertilized with urea, FYM + urea and FYM + SM + PM + U which produced grain yield kg ha^{-1}, respectively. Minimum grain yield observed in unfertilized plots (control). The planned mean comparison showed that control vs rest, organic vs inorganic, PM + U vs SM + U and PM vs SM significantly affected grain yield of wheat. Rest (treated) plots produced higher grain yield than control plots. Improvement in grain yield might be due to the more tillers^{-2}, spike m^{-2}, biomass yield, more grains spike^{-1} and greater grain weight. These results supported by Khaliq et al. (2004), (Rehman & Khalil, 2008; Hossain et al., 2002; Pedro et al., 2011). As they described that Increased in wheat grain yield with organic and N application can be attributed to more number of tillers and grains, early plant vigor, biomass yield and more grain weight. Application of sole urea produced more grain yield as compared to application of organic manures applied alone. Urea might supply more N to soil because of quick mineralization consequently boosted grain yield of wheat. These finding are in agreement with Khan et al. (2009) and (Shah and Ahmad. 2006) who reported that plots getting N only from organic manure produced significantly lowest grain yield compared with other fertilized plots. Among three organic manures, maximum grain yield was recorded in PM plots compared to other organic manures. These increased in PM Plots may be due to its low C/ N ratio. Grain yield was higher when used the combination of PM +U while, it was lower when used the SM + U. The increased of grain yield in PM + U plots because of more nutrients supply throughout the growing period. These results are also supported by the studies of Amanullah and Hidayatullah. (2016), who specified that grain yield were considerably increased by applying PM + U and were reduced after applying urea + wheat straw.

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