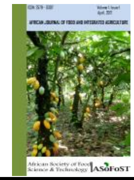
ISSN: 2579 – 0307 Afr J Food Integ Agr 2 (2018) 15-22

ASoFoST

African Journal of Food and Integrated Agriculture

Journal home page: www.asofost.org/journals/index.php/ajfia



Effect of mulch type, mulch size and nitrogen levels on wheat production

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Received November 26, 2017; Revision received February 18, 2018; Accepted March 14, 2018

Abstract

To study the effect of mulch types (soaked mulch and Unsuaked mulch) on wheat production, mulch sizes (20, 40 and 60 cm) were used at the rate of 5 t ha-1 at the time of sowing. Maize stalk was used as mulch material. Nitrogen (N) at the rate of 100, 120, and 140 kg ha-1 was also utilized. All P and K and half of the N were applied at the time of sowing while the left-over N was applied with first irrigation. Wheat variety "Siran 2010" was sown at seed rate of 100 kg ha-1 with row to row distance of 30 cm apart. The experiment was arranged in RCBD. Mulch types (soaked vs. unsoaked) had no significant effect on any of the parameters studied. Highest tillers m-2 (319), grains spike-1 (58), grain weight (38.97 g), and grain yield (4278 kg ha-1) and lower weeds density (34) were recorded with small size (20 cm) mulch. With increase in mulch size from 20 to 60 cm weeds number, Tillers m-2, and grains spike-1 decreased with increase in mulch size up to 40 cm but no significant reduction was observed at 60 cm. The effect of N application was significant on all parameters except emergence m-2. With increase in N level, increase in weeds density, tillers m-2 and biological yield was observed. Thousand grain weight and grain yield increase with increase in N but no significant increase was observed at 140 kg N ha-1. Grains spike-1 increased with increase in N up to 120 kg ha-1 and then decreased at 140 kg ha-1. It can be concluded that mulch soaking has no advantage as compared with unsoaked mulch. Mulch size of 20 cm and 120 kg N ha-1 seems to be the optimum size and level respectively for improving wheat yield.

Keywords: Mulch type; nitrogen levels; wheat production

Introduction

Wheat (*Triticum aestivum* L.) is most important cereal crop of Pakistan. It plays a vital role in GDP and making of agricultural strategies. The crop adds 10.1% to the value augmented in agriculture plus 2.2% to Gross Domestic Products (GDP) of Pakistan. In 2012-13 the crop was planted on 8693 thousand hectares area which produced 24.2 million tons (Iqbal, Bakhsh, Maqbool, & Ahmad, 2005). Its means yield of the country was 2787 kg ha^{-1}. In Khyber Pakhtunkhwa Province (Pakistan), the crop was planted on 0.78-million-hectare area which produced 1.2 million tons with 1856 kg ha^{-1} mean yield. In Pakistan, weeds are major production constraint in agricultural lands. Total yield losses in Pakistan due to weeds in wheat crop are beyond 28 billion rupees at countrywide while 2 billion rupees in Khyber Pakhtunkhwa Province (Hassan & Marwat, 2001). In addition to crop losses in terms of yield as well as quality, weeds keep on surviving and thus consume significant quantity of nutrients, water, oxygen and light from the crop and consequently have a drastic effect on crop yield (Mahmood, Azam, Hussain, & Malik, 1997).

Mostly, in Pakistan synthetic herbicides are used for weeds control but the continuous use of synthetic herbicides are not environmentally friendly and also increases herbicidal resistance in weeds (Bhadoria, 2011). Hence, research is needed to find out some natural ways for minimizing the dependency on synthetic chemicals. Now scientists are finding others ways to control weeds without using risky herbicides. All over the world mulching is known for weeds subduing. However, considering mulch type carbon-based mulch proves better than any other type of mulch; with controlling weeds reduce cost by minimizing tillage, which is generally done for abolishing weeds (Jodaugienė, Pupalienė, Urbonienė, Pranckietis, & Pranckietienė, 2006). The degree of weed control achieved by mulch will vary with the size and type of the materials used. Spaces among the larger pieces of mulch material allow the

doi:10.25218/ajfia.2018.01.001.03

weeds to grow through while the fine-textured mulches packed more tightly and hence form a more complete barrier to the weed (Kassam et al., 2012). However, organic mulch made up of smaller particles will break down faster than mulch made up of larger particles and will have to be replenished more often.

In addition to suppressing weeds mulches improve water conservation, heat energy and status of nutrients, in soil thus avoiding loss of water and soil, and stopping salts from coming out of the deep soil with water. More yield in wheat having mulching as compared with no mulch have been reported by Yang, Liu, Li, & Li (2006). Increase in crop yield with improvement in soil physico-chemical properties, water conservation and enhanced soil biological activity have been reported by Ramakrishna, Tam, Wani, & Long, (2006) and Tindall, Beverly, & Radcliffe (1991). Mulch maintains uniform soil temperature because it insulates and keeps the soil warmer during cold weather and cooler during warm weather (Erenstein, 2002). Mulching with maize straw reduce the maximum soil temperature during day by reducing the absorption of radiation by soil, but increase the soil temperature at night by reducing the outgoing of heat radiation, which reduce soil evaporation (Huang, Chen, Fu, Huang, & Gong, 2005). Bhagat and Verma (1991) reported that application of mulch might defend the fertilizers loss, particularly the volatilization loss of nitrogen fertilizers and hence the nitrogen use efficiency.

Nitrogen is crucial and one of the most yield regulating nutrients in crop production in all agro-ecological regions of the world (Fageria & Baligar, 2005). Nitrogen is very crucial for plant maturation and development. It is the basic input for achieving higher production and is needed by wheat throughout its growing period (Shah et al., 2010). Although deficient nitrogen leads to poor growth of plant and ultimately lower grain yield. Its excess is also not worthy for wheat crop. Higher nitrogen level triggers immediate depletion of soil moisture, encourages lodging, lower resistance to leaf diseases, and slow down ripeness. Increasing rate of nitrogen increase tillers m^{-2}, spikes m^{-2} and grain yield described by Tripathi, Sayre, Kaul, & Narang (2003) and Ali et al. (2011). Recommended N application rate for wheat is 120 kg ha^{-1}, which might be unique under the improved moisture made by mulching (Chakraborty et al., 2010). Information regarding comparative effects of various types of mulches with different particle sizes and N amounts on wheat is insufficient. So, the current experiment was undertaken to catch on the effect of mulch types, mulch sizes with different nitrogen amount on wheat yield.

Materials and methods

Materials

A field research on the effect of mulch type, size and nitrogen amounts on wheat yield was performed at Agronomy Research Farm of The University of Agriculture, Peshawar during Rabi season during of 2013-14. Maize stalks were acquired from the university farms and Nitrogen (M-8085-N1, AccuStandards, phosphorus [IMDG (P.8208) Class 8, Group II, ICAO/IATA Class II] and potassium (972.4.8469963, Haifa Group) were purchased from recognized agrochemical shops.

Methods

Experimental design

The experiment was carried out in randomized complete block design with four replications. The size of subplot was 4 m x 1.8 m. Maize stalk used as mulch material at the rate of 5 t ha-1, were cut into three sizes with meat cleaver and before application to the field were soaked in separate ditches for 24 hours. Wheat variety "Siran 2010" was seeded at the rate of 100 kg ha-1 with the assistance of drill in the first week of November. There were six rows with row to row distance of 30 cm. All the phosphorus and potassium and half of the nitrogen were used at the time of seeding and the left-over N was used with first irrigation. Mulching was done just after sowing. The factors and their levels applied are shown in Table 1.

Table1: Test parameters and their levels

	Description	
Factors	Codes	Levels
Mulch type	M1	Maize stalk soaked
	M2	Maize stalk unsoaked
Mulch size (cm)	S1	20
	S2	40
	S3	60
N levels (kg ha-1)	N1	100
	N2	120
	N3	140

Note. One plot was as check plot / replication.

Data recording procedure

Data regarding emergence m^{-2} one meter was noticed by counting the numbers of seedlings in one-meter length of three central rows after the accomplishment of 90% emergence in each subplot. The counted seedlings were then transformed into emergence m^{-2} one meter via the succeeding formula (Eq. 1):

$$Emergence\ (m^2) = \left[\frac{Total\ №\ of\ seedlings\ emerged}{R-R \times №\ rows \times row\ length}\right] \times 1 \quad \text{... Eq. 1}$$

Weeds m^{-2} was calculated by counting the number of weeds in three central rows in one-meter length and then were changed into weeds m^{-2}. One-meter Data on number of tillers (m^{-2}) were taken by counting the numbers of tillers in central three rows of each sub plot, and then transformed into numbers of tillers m^{-2}. Data on plant height (cm) were noted by measuring arbitrarily selected 10 plants in each subplot from bottom of plant to the tip of spikes at physiological maturity. Data concerning spike weight (g) were recorded by weighing five dry spikes indiscriminately selected in each sub plot and then average was determined. Data regarding number of grains $spike^{-1}$ were recorded by counting wheat grains in erratically nominated five spikes in each subplot and averaged appropriately. Data about thousand grains weight (g) were noted on sensitive electronic balance after counting thousand grains with the aid of seed counter for each subplot. Data on biological yield (kg ha^{-1}) were noted by reaping four central rows in each subplot and then sun dried, weighed and then transformed to kg ha^{-1}. Data on grain yield (kg ha^{-1}) were recorded by threshing separately the four central rows taken for biological yield; the grains were then weighed and changed into kg ha^{-1}. Harvest index was worked out by means of the given formula (Eq. 2);

$$Harvest\ index = \frac{Economic\ yield}{Biological\ yield} \times 100 \quad \text{... Eq. 2}$$

Statistical analysis

The data were probed statistically with analysis of variance methods proper for randomized complete block deign. Significant differences among treatments were exposed via least significant difference (LSD) test at 5% level of probability for main as well as interaction effects (Steel and Torrie, 1984). All recordings were taken in triplicates.

Results and discussion

Results

Emergence

Data concerning emergence m^{-2} are exposed in Table 2. The data shows that mulch type, size and nitrogen have no effect on emergence m^{-2}. Control plots had significantly lower emergence m^{-2} (89) as equated with the rest of the treatments.

Weeds density (m^{-2})

Average values of the data relating to weed m^{-2} shown in Table 2 were significantly affected by mulch sizes and nitrogen levels and the interaction between mulch sizes (S) x nitrogen levels (N) was also significant. Comparison of mean values indicated that significantly higher number of weeds was observed in check plots (51) compared with rest of the treatments (37). Minimum weeds m^{-2} (34) were recorded in 20 cm mulch applied plots and weed density increased with increase in mulch size from 20 to 40 cm but no significant difference was observed at 60 cm mulch size. With increase in nitrogen levels significant increase was observed in weed density as maximum weeds m^{-2} (39) were noted in plots treated with 140 kg N ha^{-1} trailed by 120 kg N ha^{-1} while minimum weeds m^{-2} (32) were observed in plots where 100 kg N ha-1 was used. The interaction between nitrogen and mulch size was significant for number of weeds m^{-2}. For 20 and 40 cm mulch size higher number of weeds m^{-2} (40,40) were determined at 140 kg N ha^{-1} but however it was noticeably different from weed density (37,39) at 120 kg N ha^{-1}. Where for 60 cm mulch size number of weeds m^{-2} were statistically same for all N levels.

Tillers (m^{-2})

Data involving tillers m^{-2} (Table 2) uncovered that mulch sizes and nitrogen levels had substantially influenced tillers (m^{-2}) Lower tillers (212 m^{-2}) were recorded in control plots compared to the rest (307 m^{-2}). In case of mulch sizes, higher tillers (319 m^{-2}) were recorded with 20 cm mulch size and lower tillers (m^{-2}) in plots where mulch size of 60 cm (301 m^{-2}) was applied. With nitrogen levels, significantly lower tillers (295 m^{-2}) were seen with 100 kg N ha^{-1} and significantly greater tillers (315 m^{-2}) were noted with 140 kg ha^{-1} N matched with 120 kg ha^{-1}.

Plant height (cm)

Mean values of plant height as depicted in Table 2 showed that mulch type, mulch size and nitrogen level have no effect on plant height. Plots without addition of mulch and nitrogen had significantly dwarf plants (94 cm) as compared with the rest of treatments height (98 cm).

Spike weight

Data regarding spike weight (g) shown in Table 3 were notably influenced by mulch sizes and nitrogen amounts. Average values of the data exhibited that higher weight of spike (3.78 g) was noted with 20 cm size mulch and lower (2.83 g) in control plots. In case of nitrogen levels, higher weight (3.72 g) was perceived with 140 kg N ha^{-1} while lower weight of spike (3.52 g) with 100 kg N ha^{-1}. With mulch sizes, heavy spike weight (3.78 g) was observed in plots where 20 cm mulch size was used and lower (3.57 g) with particle size of 60 cm.

Grains $spike^{-1}$

Mean values of the data shown in Table 3 revealed that mulch sizes and nitrogen levels had substantially influenced grains $spike^{-1}$. Significantly higher grains $spike^{-1}$ (58) was noted with 20 cm mulch applied plots though; distinction between 40 cm & 60 cm mulch applied plots was not noteworthy. With the case of nitrogen, significantly lower number of grains $spike^{-1}$ (55) was gained with 100 kg N ha^{-1} and significantly greater grains spike^{-1}(60) was noted with 120 kg N ha^{-1} as matched with 140 kg N ha^{-1} (57). Control plots had significantly lower grains spike^{-1} (53) as equated with the remaining treatments (58).

Table 2: Some growth parameters of wheat as affected mulch types, mulch sizes and nitrogen levels

Factors	Levels	Growth Characteristics			
		Emergence (m^{-2})	Weed density (m-2)	Tillers (m-2)	Plant height (cm)
Mulch Types	Soaked	102.58 ^{a}	37.31 ^{a}	309.97 ^{a}	98
	Un-soaked	101.97 ^{a}	35.75 ^{b}	304.36 ^{b}	98
	LSD (P<0.05)	0.44	0.04	0.02	ns
Mulch Size (cm)	20	103.33 ^{a}	33.79 ^{b}	319.21^{a}	98
	40	101.71 ^{b}	37.88 ^{a}	301.25 ^{b}	99
	60	101.79^{b}	37.92 ^{a}	301.04 ^{b}	98
	LSD (P<0.05)	0.04	0.3	0.03	ns
Nitrogen levels (Kg ha-1)	100	101.50 ^{a}	32.42 ^{c}	295.25^{c}	97
	120	103.75 ^{b}	37.83 ^{b}	311.42 ^{b}	98
	140	101.58 ^{a}	39.33 ^{a}	314.83 ^{a}	99
	LSD (P<0.05)	0.04	0.02	3.43	ns
Control vs Rests	Control (C)	88.75 ^{b}	51.00 ^{a}	212.50 ^{b}	94 ^{a}
	Rest (R)	102.28 ^{a}	36.53 ^{b}	307.17 ^{a}	98 ^{b}
	LSD (P<0.05)	0.01	0.03	0.04	0.04
Interactions	M x S	Ns	Ns	Ns	Ns
	M x N	Ns	Ns	Ns	Ns
	S x N	Ns	Ns	Ns	Ns
	M x N x S	Ns	Ns	Ns	Ns

Means is similar category of columns and rows with different alphabets differ significantly from each other at p<0.05 using LSD. NS= non-significant

Thousand (1000) grain weight

Mean values of Table 3 revealed that mulch sizes and nitrogen levels had substantial impact on thousand grain weight (g). Thousand grain weight decreases with increase in mulch sizes. Significantly higher thousand grain weight (38.97 g) was noted with 20 cm mulch and lower (37.88 g) was recorded in 60 cm mulch applied plots. Thousand grain weight increases with increase in nitrogen level as a result significantly higher grain weight (39 g) was achieved with 140 kg N ha^{-1} as compared with 100 kg ha^{-1} (37.17 g) however, statistically similar with those of 120 kg N ha^{-1} (38.88 g). Substantially lesser 1000 grain weight (34 g) was noticed in control plots as compared with the rest of the treatments (38.35 g).

Biological yield

Table 4 shows that, biological yield (t ha^{-1}) of the crop was significantly affected by N levels while mulch type and mulch sizes had no effect on biological yield. Comparison of the mean values showed that significantly higher biological yield (11.3 t ha^{-1}) was documented with 140 kg N ha^{-1} compared with 120 kg N ha^{-1} (11.1 t ha^{-1}) and significantly lower (10.6 t ha^{-1}) was seen with 100 kg N ha^{-1}. Significantly lower biological yield (9.1 t ha^{-1}) was noticed in check plots as equated with the remaining treatments (11 t ha^{-1}).

Grain yield

Data concerning grain yield (kg ha^{-1}) is displayed in Table 4. Mean values shows that mulch sizes and nitrogen levels had significantly affected grain yield. Comparison of mean values indicated that considerably greater grain yield (4278 kg ha^{-1}) was acquired with 20 cm mulch and significantly lower grain yield (4020 kg ha^{-1}) was seen with 60 cm mulch applied plots. In nitrogen levels, higher grain yield (4287 kg ha^{-1}) was attained with 140 kg N ha^{-1} which is however non-significant with grain yield (4253 kg ha^{-1}) gained with 120 kg ha^{-1} and a significantly lower grain yield (3850 kg ha^{-1}) was achieved with 100 kg N/ha.

Check plots receiving no nitrogen and no mulch had substantially lower grain yield (2967 kg ha^{-1}) compared with the rest of the treatments (4130 kg ha^{-1}).

Table 3: Spike weight, Grains spike^{-1} and 1000 grain weight of wheat as affected mulch types, mulch sizes and nitrogen levels

Factors	Levels	Spike weight (g)	Grains spike^{-1}	1000 grains weight (g)
Mulch Types	Soaked	3.7±0.02^{a}	57.98±0.12^{a}	38.39±0.19^{a}
	Un-soaked	3.6±0.07^{a}	57.46±0.16^{a}	38.31±0.15^{a}
	LSD (P<0.05)	Ns	0.14	0.12
Mulch Size (cm)	20	3.78±0.01 ^{a}	58.48±0.13 ^{a}	38.97±0.19 ^{a}
	40	3.60±0.03 ^{b}	57.23±0.19 ^{b}	38.21±0.16 ^{b}
	60	3.57±0.05 ^{b}	57.43±0.14 ^{b}	37.88±0.18 ^{c}
	LSD (P<0.05)	0.04	0.01	0.04
Nitrogen levels (Kg ha^{-1})	100	3.53±0.07 ^{b}	55.45±0.12 ^{c}	37.17±0.12 ^{b}
	120	3.71±0.02 ^{a}	60.40±0.18 ^{a}	38.88±0.11 ^{a}
	140	3.72±0.03 ^{a}	57.29±0.15 ^{b}	39.00±0.13 ^{a}
	LSD (P<0.05)	0.04	0.02	0.03
Control vs Rests	Control (C)	2.83±0.21 ^{b}	52.75±0.08 ^{b}	34.00±0.08 ^{b}
	Rest (R)	3.65±0.05 ^{a}	57.72±0.02 ^{a}	38.35±0.02 ^{a}
	LSD (P<0.05)	Ns	0.02	0.01
Interactions	M x S	Ns	Ns	Ns
	M x N	Ns	Ns	Ns
	S x N	Ns	Ns	Ns
	M x N x S	Ns	Ns	Ns

Means is similar category of columns and rows with different alphabets differ significantly from each other at p<0.05 using LSD. NS= non-significant.

Harvest index

Table 4 represents the data of harvest index (%). Harvest index was prominently influenced by mulch sizes and nitrogen amounts. Average values indicated that significantly higher harvest index (38.42%) was noted with 120 kg N ha-1 and significantly lower harvest index (36.34%) was noted with 100 kg N ha-1. In the case of mulch sizes, significantly higher harvest index (38.58%) was achieved with 20 cm mulch size followed by 40 cm (37.18%) and lower harvest index (37.08%) with 60 cm mulch. Control plots had significantly lower harvest index (33.06%) as compared with rest of the treatments (37.61%).

Discussion

Emergence (m^{-2}) was not considerably influenced by the mulch types, mulch sizes and nitrogen application. Control plots had significantly lower emergence as compared with treated plots. Higher emergence in treated plots could be due to increase in temperature.

Significant effect of mulch sizes and nitrogen levels was recorded on weeds density m^{-2}. Interaction between mulch sizes and nitrogen levels was also significant while mulch type has no significant effect on the weed density m^{-2}. Control plots had significantly more weeds m^{-2} as compared with rest. The lower weeds m^{-2} could be due to the covering of soil with mulches. Our outcomes are in accordance with those narrated by Pullaro, Marino, Jackson, Harrison, & Keinath (2006) and Hiltbrunner, Liedgens, Bloch, Stamp, & Streit (2007).

Similarly, (Broschat, 2007) conveyed that organic mulch of any type reduces weed density. Smaller sizes of mulch were more successful in restricting weeds as result fewer weeds were recorded in 20 cm as compared with 40 and 60 cm mulch size. These consequences are defended by Jodaugienė et al., (2006). The interaction between nitrogen and mulch size had considerably influenced number of weeds (m^{2}) For 20 and 40 cm mulch size higher number of weeds m^{-2} (40,40) were noticed at

140 kg N ha^{-1} however it was statistically distinct from weed density (37,39) at 120 kg N ha^{-1}. Where for 60cm mulch size number of weed m^{-2} were statistically same for all N levels. Mulch sizes and nitrogen levels had significantly affected fresh biomass of weeds. Markedly, higher biomass of weeds was recorded in control plots compared with the treated plots.

Table 4: Biological yield, Grain yield and Harvest index (%) of wheat as affected mulch types, mulch sizes and nitrogen levels

Factors	Levels	Biological Yield (t ha^{-1})	Grain yield (kg ha^{-1})	Harvest index (%)
Mulch Types	Soaked	11.07±0.02^{a}	4146.07±0.34^{a}	37.44±0.07^{a}
	Un-soaked	10.89±0.07^{a}	4113.88±0.57^{b}	37.79±0.02^{a}
	LSD (P<0.05)	0.05	0.03	Ns
Mulch Size (cm)	20	11.09±0.03^{a}	4278.50±0.94 ^{a}	38.58±0.25 ^{a}
	40	11.08±0.05^{a}	4091.73±0.61 ^{b}	37.18±0.34 ^{b}
	60	10.85±0.87^{a}	4019.70±0.10 ^{c}	37.08±0.86 ^{b}
	LSD (P<0.05)	0.07	0.04	0.03
Nitrogen levels (Kg ha^{-1})	100	10.61±0.15 ^{c}	3850.17±0.05 ^{b}	36.34±0.15 ^{c}
	120	11.07±0.05 ^{b}	4252.96±0.96 ^{a}	38.42±0.25 ^{a}
	140	11.26±0.01 ^{a}	4286.79±0.87 ^{a}	38.08±0.19 ^{b}
	LSD (P<0.05)	0.07	37.85	0.23
Control vs Rests	Control (C)	9.07±0.15 ^{b}	2966.53±0.75 ^{b}	33.06±0.11^{b}
	Rest (R)	10.98±0.19 ^{a}	4129.97±0.62 ^{a}	37.61±0.15 ^{a}
	LSD (P<0.05)	0.04	0.03	0.01
Interactions	M x S	Ns	Ns	Ns
	M x N	Ns	Ns	Ns
	S x N	Ns	Ns	Ns
	M x N x S	Ns	Ns	Ns

Means is similar category of columns and rows with different alphabets differ significantly from each other at p<0.05 using LSD. .NS= non-significant

Biomass of weeds increased with increase in sizes of the mulch material (Table 2). From 20 to 60 cm small size mulch may have been packed closely on the surface of the soil and might fully cover the soil while same amount but larger pieces of mulch may leave spaces on the soil which allow the weeds to grow through it which compete for resources and so photosynthesize well. These outcomes are upheld by Kamara, Akobundu, Chikoye, & Jutzi (2000); Bilalis, Sidiras, Economou, & Vakali (2003) and Rahman, Chikushi, Saifizzaman, & Lauren (2005) who registered that growth and biomass of weeds was significantly diminished by mulching as matched with check plots. Weed density in case of 60 cm mulch size was not affected by N level however at lower level of N 20 cm was more effective in controlling weeds than others. With augmentation in N from 120 to 140 kg ha^{-1} both the sizes had same effect. Plant height was not affected by mulch types, mulch sizes and nitrogen levels. Control plots having no nitrogen and no mulch produced significantly dwarf plant as compared with the treated plots. These findings are in contrary with Chakraborty et al. (2010) who specified that plant heightens with increase in nitrogen levels. However, these outcomes are in harmony with Rahman et al. (2005) who observed taller plant in treated plots as compared with control.

Mulch size and nitrogen levels had considerable influence on tillers m^{-2}. Comparison of mean values exhibited that extensively higher tillers m-2 were recorded at 20 cm mulch while lower tillers m^{-2} was recorded with 60cm mulch which was statistically at par with 40 cm mulch size. Matching effects were obtained by Rahman et al. (2005) who narrated higher tillers m^{-2} in mulched plots as compared to control. This might be due to conserved soil moisture and increase in soil temperature during winter which may promote the crop growth and development (Fan et al., 2005; Huang et al., 2005).

Data regarding spike weight was remarkably influenced by mulch sizes and nitrogen rates while mulch types have no effect on the weight of spike. In the case of mulch size, significantly heavy spikes were noted in plots where 20 cm mulch size were used and lowers spike weight with 60 cm size mulch application. With increase in nitrogen level spike weight increases and higher weight of spike was recorded with 140 kg N ha^{-1} which is statistically similar with 120 kg N ha^{-1} and significantly lower spike weight was noted with 100 kg N ha^{-1}. Significantly minimal weight of spike was seen in check plots as compared with the treated plots.

Grains spike^{-1} is thought to be another most important yield component which affects wheat grain yield directly. Mulch sizes and nitrogen levels had significantly affected grains spike^{-1}. Mulch types had no significant effect on the grains spike^{-1}. Comparison of mean values showed that greater number of grains spike^{-1} was achieved with 120 kg N ha^{-1} while significantly lower grains spike^{-1} with 100 kg N ha^{-1}. In the case of mulch size, significantly more number of grains spike-1 was listed with 20 cm mulch size and lower with 40 cm and 60 cm mulch size. These conclusions are upheld by Rahman et al., (2005) who portrayed greater number of grains spike^{-1} with mulching matched to non-mulch plots. They also reported that grains spike^{-1} increases with increase in nitrogen up to 120 kg N ha^{-1}.

Biological yield of wheat was greatly altered by nitrogen amounts. Comparison of mean values showed that significantly higher biological yield was noticed with 140 kg N ha^{-1} compared with 120 kg N ha^{-1} and significantly lower biological yield was perceived with 100 kg N ha^{-1}. The higher biological yield with increasing nitrogen amounts may perhaps be due to bettered vegetative growth of wheat & in addition to higher number of tillers m-2 with increase in nitrogen level. These outcomes are similar with Shah et al., (2010) and Geleto, Tanner, Mamo, & Gebeyehu (1995) who reported that biological yield increases with enhancement in nitrogen rate up to 120 kg N ha^{-1}. Significantly lower biological yield was noted in control plots compared with the treated plots which possibly will be due the high competition of unwanted plant with the crop and/or might be due to the low temperature during winter.

Grain weight is also one of the most important yield parameters that directly affects grain yield of wheat. Thousand grain weight increases with increase in nitrogen levels. Higher grain weight was recorded with 140 kg N ha^{-1} which is statistically at equivalency with 120 kg N ha^{-1} whereas significantly lower thousand grain weight was noted with 100 kg N ha^{-1}. Mulch sizes had extensively affected thousand grain weight. These outcomes are in concurrence with those of Rahman et al. (2005) who listed that grain weight increases with increase in nitrogen level. However, they reported that mulch treatment had no effect on thousand grain weight.

Grain yield was notably influenced by mulch sizes and nitrogen amounts. Mulch types have no effect on the grain yield of wheat. Significantly higher grain yield was noted with 20 cm compared with 40 cm and significantly lower grain yield was recorded with 60 cm mulch size. 20 cm mulch size control weeds better than 40 cm and 60 cm mulch sizes and also might maintained optimum soil temperature and conserve soil moisture and were used in biological activities and hence attributed to higher grain yield. In the case of nitrogen, higher yield was achieved with 140 kg N ha^{-1} which is however statistically non-significant with 120 kg ha^{-1} and significantly lesser grain yield was obtained in plots where 100 kg N ha^{-1} was experimented. The outcomes are in concordance with Rahman et al. (2005) who conveyed higher grain yield of wheat under rice straw mulch compared with non-mulch plots and they also reported rise in grain yield with augmentation in N rate up to 120 kg N ha^{-1}.

Mulch size and nitrogen levels had significantly affected harvest index of wheat while mulch types had no effect on harvest index. Harvest index decreases with increase in mulch size up to 40 cm. Significantly higher harvest index was recorded with 20 cm mulch followed by 40 cm size and lower harvest index was recorded with 60 cm size mulch application. In the case of nitrogen, application120 kg N ha^{-1} exposed substantively higher harvest index while 100 kg N ha^{-1} offered significantly lesser harvest index. The results are in similarity with Mohtisham, Ahmad, Ahmad, & Aslam (2013)who reported greater harvest index with maize stalk mulch and polythene sheet mulch than control.

Conclusion

On the basis of the above summarized findings it can be concluded that mulch soaking has no additional benefit on grain parameter as compared with unsoaked mulch. Mulch size of 20 cm and 120 kg N ha-1 seems to be the extremely favorable mulch N application size and level respectively for improving crop yield as compared to the other mulch sizes and nitrogen levels.

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