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Potential Role of Wheat Varieties in Semi-arid Areas of India with Diverse Mulch Materials

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ABSTRACT: Due to restricted area, increase in crop productivity is the sole choice to fulfil the demand of burgeoning population. In arid and semi-arid regions, wheat yields are considerably constrained by the inadequate water and nutrients supply. Additionally, the regions that are self-sufficient in water and nutrients often have low nutrient and water use efficiency because of inadequate management, resulting in substantial losses in wheat grain output. Increased moisture shortage during the wheat growing season leads to detrimental effect on the plant's growth and development. Suitability of cultivars to a specific agro-climate is critical for maximising their yield potential, as plant production efficiency is governed by genotype-environment (G × E) interaction. The environmental conditions that prevail over a particular agro-climatic zone are immutable. However, a crop's agronomic methods can be modified to take maximum advantage of environmental elements and to best suit the crop's developmental stages. One of the most effective agronomic practises for water-scarce areas is the use of crop residues as a soil cover (mulch) in conservation agriculture (CA). Hence, field experiment was undertaken during *Rabi*, 2019-20 at research farm of CCS Haryana Agricultural University, Hisar, Haryana. The layout of experiment was RBD with six wheat varieties (V_1-WH 1142, V_2-WH 1105, V_3-HD 2967, V_4-WH 1184, V_5-HD 3086 and V_6-WH 1124) and three mulch treatments (M_1- No mulch, M_2- Rice straw mulch @ 6 t/ha and M_3- Plastic mulch) having three replications. Utilization of mulch improved the growth parameters in terms of dry matter accumulation and LAI except plant population. Highest dry matter accumulation and LAI recorded in WH 1142. Crop under (M_2) rice straw mulch reported more soil moisture content and available soil nutrients than (M_3) plastic mulch and (M_1) no mulch. Sowing of wheat under (M_2) rice straw mulch resulting in 29.75 percent higher grain yield than (M_1) no mulch. Variations were significant in terms of yield attributes in varieties. Highest grain yield and biological yield were obtained from WH 1142.

Keywords: dry matter accumulation, growth parameters, soil moisture content and yield attributes.

INTRODUCTION

Wheat (*Triticum aestivum* L.), a member of *Poaceae* family, is the second most important crop grown on a large scale in world and the most consumed food crop after rice, and plays a significant role in the global economy. It contributes almost 35 per cent of the national food supply and is critical for food and nutritional security. It contains approximately 13% protein, 70% carbohydrates, 2.7 percent minerals, 1.7 percent fats, 2% fibre, and 13% moisture (Sharma and Jain 2014). It can be grown not only in tropical and subtropical zones but also in the temperate zone and the cold tracts of the far north, beyond even the 60° North latitude. Wheat can be cultivated from sea level to as high as 3,300 m. Wheat grains are comparatively better source of protein about 10-12%. In India, cultivated on an area of 31.12 million hectares and 109.58 million tons of total production with an average 3521 kg ka^{-1}. In Haryana, wheat is the cultivated in an area of 2.56 million hectare with an annual production of 12.39 million tonnes with average productivity of 4834 kg ha^{-1} (Anonymous, 2021). In India, its production has risen from 6.5 Mt. in 1960 to 109.58 Mt. in 2020–21 (Directorate of Economics and Statistics, 2021).

By 2050, demand for wheat in developing countries such as India will climb by 60%. (CIMMYT, 2013). Thus, in order to ensure sustainable food supply and to feed an ever-growing population, wheat yields must be increased. Wheat yields can be increased by the use of appropriate agronomic measures and high yielding varieties. However, in Haryana due to limited land resources and high population density horizontal expansion of wheat area is not possible. Therefore, increasing production of wheat by vertical ways *i.e.* agronomic management practices may be most suitable, viable and practical approach under such circumstances (Mandal *et al.,* 2013). There are several factors accountable for lower productivity of wheat, like delay in sowing, selection of unsuitable varieties, inappropriate seeding rates, improper planting geometry, unavailability of water for irrigation purpose and soil type. Out of these factors, the availability of proper soil moisture and varietal selection are critical, as they contribute to the country's low wheat production. By 2050, it is anticipated that a sustainable increase in global food supply of 70-100 percent will be required to feed 9 billion people (Godfray *et al*., 2010).

Due to restricted area, increase in crop productivity is the sole choice to fulfil the demand of burgeoning population. In arid and semi-arid regions, wheat yields are considerably constrained by the inadequate water and nutrients supply. Additionally, the regions that are self-sufficient in water and nutrients often have low nutrient and water use efficiency because of inadequate management, resulting in substantial losses in wheat grain output. Increased moisture shortage during the wheat growing season leads to detrimental effect on the plant's growth and development. Suitability of cultivars to a specific agro-climate is critical for maximising their yield potential, as plant production efficiency is governed by genotype-environment (G × E) interaction. The environmental conditions that prevail over a particular agro-climatic zone are immutable. However, a crop's agronomic methods can be modified to take maximum advantage of environmental elements and to best suit the crop's developmental stages. One of the most effective agronomic practises for water-scarce areas is the use of crop residues as a soil cover (mulch) in conservation agriculture (CA). Rice straw mulch considerably increased growth metrics, yield characteristics and yield as well as N, P and K content and NPK absorption by straw (Nagora *et al*., 2022).

Furthermore, selection of crop variety can have a significant impact on crop-weed competition. Planting the appropriate variety at the appropriate time ensures that the crop will mature at the optimal time for soil moisture and temperature. The literature review suggests that few research have been undertaken on wheat crop varieties and mulch materials to determine their effect on crop growth characteristics and soil properties. Hence, an experiment has been conducted to know the potential of different wheat genotypes under different mulch material in semi-arid region of Haryana.

MATERIAL AND METHODS

The present study was done in *Rabi*, 2019-20 at the Agronomy Farm of CCS HAU in Hisar, Haryana, which is located at 29°10' N latitude and 75°46' E longitude and has an elevation of 215.2 m above mean sea level. Hisar is located in the tract of semi-arid and subtropical monsoonal climate. The main features of climate in Hisar are dryness, high temperature and scanty rainfall. Availability of favourable temperature and solar radiation proved conducive for growth and yield attributing characters and eventually to the higher yield. The experimental material was consists of six wheat varieties (V_1-WH 1142, V_2-WH 1105, V_3-HD 2967, V_4-WH 1184, V_5-HD 3086 and V_6-WH 1124) and three mulch treatments (M_1- No mulch, M_2- Rice straw mulch @ 6 t/ha and M_3- Plastic mulch) having random block design (RBD).

Soil analysis of the experimental field: Random soil samples were taken from 0-15 cm soil profile depth before sowing of the experiment field. Then soil samples collected from various plots of experiments field were mixed, air dried, well ground to pass through 2 mm sieve. After that for determining chemical properties of the soil of experimental field, samples were composited and analysed.

Chemical composition of soil: The chemical analyses of the soil were carried out with standard methods. The values of soil available N, P and K were determined with standard techniques and given in Table 1.

Table 1: Chemical composition of soil (0-15 cm).

Soil parameters	Value Recoded	Method of estimation
Available N (kg ha^{-1})	186.20	Alkaline permanganate method (Subbiah and Asija 1956)
Available P_2O_5 (kg ha^{-1})	38.47	Olsen's method (Olsen *et al*., 1954)
Available K_2O (kg ha^{-1})	348.80	Flame photometer method (Richards, 1954)

The above analyses indicate that the soil of experimental site was low in organic carbon and nitrogen, medium in phosphorus and rich in potassium and slightly alkaline in reaction.

Observations recorded: Plants in per metre row length, representing the whole plot, were cut close to the ground at 30, 60, 90 DAS and at harvest to record dry matter accumulation per metre row length. These samples were first sun dried and then oven dried at 65°C ± 2°C till a constant weight was obtained at each stage. After drying, the samples were weighed for recording dry weight in grams per metre row length (g/mrl). Leaf area index was measured at 30, 60 and 90 DAS with the help of leaf area meter (L1 3000 Area meter LICOR Ltd. Nebraska, USA). For yield attributes, traits *viz.,* Grain yield (kg/ha), Straw yield (kg/ha) and biological yield (kg/ha) was measured and calculated. Soil available N, P, K content was measured by the method as mentioned in Table 1. Soil moisture from soil sample was determined from each plot at the depths of 0-15 and 15-30 cm at 30, 60, 90 DAS and at harvest with the help of auger and kept into moisture aluminium boxes. Boxes were kept in hot air oven at 70°C after measuring the initial weight, till the constant weight was obtained. Soil moisture percentage on oven dry weight basis was calculated as under:

$$\text{Moisture percentage} = \frac{\text{Weight of moist soil (g)} - \text{Weight of oven dried soil (g)}}{\text{Weight of oven dried soil (g)}} \times 100$$

Statistical analysis: Data collected during the study were statistically analyzed by using the technique of analysis of variance (ANOVA) as applicable to Split plot design (Gomez and Gomez 1984).

RESULTS AND DISCUSSIONS

Growth parameters. Growth is a gradual development in size, weight or height, age and maturity or is a permanent gain in the plant's volume, dry weight and size. Moreover, different varieties responded differently to agroclimatic conditions. So, screening of many varieties is necessary to select those which perform better under diverse weather conditions and can ultimately mitigate the negative impacts of environmental conditions on overall productivity of wheat. Therefore, combination of soil cover (mulch) and varieties can prove to be better alternative under the concept of conservation agriculture (CA) in order to obtain high crop productivity.

Dry matter accumulation. Dry matter accumulation (Table 2) of different wheat varieties varied significantly during all crop stages except at 30 DAS. At 60, 90 DAS and at harvest, WH 1142 produced 59.92, 159.84 and 358.59 g mrl^{-1} dry matter, respectively, which was significantly higher than rest of the varieties. On contrary to, HD 2967 reported 21.10, 82.69 and 281.27 dry matter accumulation (g per metre row length) at 60, 90 DAS and at harvest, respectively. This was because of similar pattern of plant height as dry matter accumulation depends on the height of plant. Significant differences among varieties with respect to dry matter accumulation was also reported by Singh *et al*. (2017). These results were also in confirmation with the literatures of Bhardwaja *et al.* (2010); Kumar (2012); Alam *et al*. (2013); Kumar (2013); Deshmukh *et al*. (2015); Akter *et al*. (2018).

Dry matter accumulation rises with the progress of phenological stages (Table 2). Moreover, the highest dry matter of 4.19, 43.16, 168.94 and 363.67 g per metre row length was observed in (M_2) rice straw mulch at 30, 60, 90 DAS and at harvest, respectively. Whereas, the lowest dry matter of 4.11, 22.02, 85.95 and 284.59 g per metre row length was obtained from (M_1) no mulch treatment (control) at 30, 60, 90 DAS and at harvest, respectively. Although, plant population was less under rice straw due to load of mulch, but later it was curtailed by producing more no. of tillers as documented by Ram *et al*. (2013). The findings are in agreement with the results of Akter *et al*. (2018).

Table 2: Effect of different mulch materials on Dry Matter accumulation (g per metre row length) at 30, 60, 90 and at harvest on different wheat varieties.

Treatments	30 DAS	60 DAS	90 DAS	At Harvest
Varieties				
V_1- WH 1142	4.41	59.92	159.20	358.59
V_2- WH 1105	3.49	28.73	137.86	336.60
V_3- HD 2967	5.76	21.10	82.69	281.27
V_4- WH 1184	3.24	21.82	134.91	333.55
V_5- HD 3086	3.92	45.97	142.88	341.52
V_6- WH 1124	4.11	21.63	119.20	309.88
SE(m)	0.70	0.16	3.70	0.53
CD (p=0.05)	NS	0.46	10.69	1.54
Mulches				
M_1- No mulch	4.17	22.02	85.95	284.59
M_2- Rice straw mulch @ 6 t/ha	4.19	43.16	168.94	363.67
M_3- Plastic mulch	4.11	34.40	133.80	332.44
SE (m)	0.49	0.11	2.62	0.38
CD (p=0.05)	NS	0.33	7.56	1.09

Leaf area index. Data revealed in Table 3 showed that among varieties, significantly higher leaf area index (1.17, 1.24 and 4.62) was recorded from variety WH 1142 at 30, 60 and 90 DAS, respectively. On the contrary, the lowest LAI (0.71, 1.05 and 2.52) was recorded from HD 3086 at 30, 60 and 90 DAS, respectively. Variability among the varieties with respect to LAI might be due to their genetic makeup. This result has similarity with the findings of Kumar (2012); Akter *et al.* (2018). This is because sufficient soil moisture was available underneath various mulch materials throughout the growth season, increasing the leaf area of the crop and allowing it to collect more incoming radiation. Another possibility is that there was variance in PAR interception and maximum.

It has been found that there is positive effect of application of crop residues as mulch on leaf area index of wheat crop which was previously demonstrated by Xie *et al.* (2005). Rice (M_2) straw mulch reported significantly higher LAI of 1.39, 1.25 and 4.82 at 30, 60, 90 DAS, respectively, followed by (M_3) plastic straw mulch. On the contrary, the minimum LAI of 0.64, 1.09 and 2.36 reported under (M_1) no mulch treatment, respectively. PAR interception was reported at highest LAI. The findings corroborate those of Yang *et al.* (2006); Ram *et al*. (2013); Sakia *et al*. (2014); Akter *et al*. (2018); Dhaliwal *et al*. (2019).

Table 3: Effect of different mulch materials on LAI at 30, 60 and 90 DAS on different wheat varieties at 30, 60 and 90 DAS.

Treatments	30 DAS	60 DAS	90 DAS
Varieties			
V_1- WH 1142	1.17	1.24	4.62
V_2- WH 1105	0.98	1.16	3.19
V_3- HD 2967	1.11	1.24	3.59
V_4- WH 1184	1.01	1.19	3.36
V_5- HD 3086	0.71	1.05	2.52
V_6- WH 1124	0.96	1.14	2.83
SE(m)	0.03	0.01	0.04
CD (p=0.05)	0.07	0.02	0.11
Mulches			
M_1- No mulch	0.64	1.09	2.36
M_2- Rice straw mulch @ 6 t/ha	1.39	1.25	4.82
M_3- Plastic mulch	0.94	1.17	2.88
SE (m)	0.02	0.01	0.03
CD (p=0.05)	0.05	0.02	0.08

Yield attributes and yields

Grain yield and Straw yield. Grain yield and straw yield markedly influenced by varieties and mulches. Among wheat varieties, highest grain yield (Table 4) was observed in WH 1142 (5466 kg/ha) which was at par with HD 2967 (5233 kg/ha), while lowest grain yield was recorded in WH 1105 (3477 kg/ha). This might be because the grain production is determined by yield-contributing features such as the number of spikelets per spike as well as growth parameters such as LAI, dry matter buildup, and photosynthate partitioning. The findings are consistent with those of Mahajan and Nagarajan (2015); Kumar *et al*. (2010); Purshotam *et al.* (2010); Ram *et al.* (2012); Deshmukh *et al*. (2015); Mani *et al.* (2016); Verma (2015); Shirinzadeh *et al*. (2017); Singh *et al*. (2017); Yadav *et al*. (2017). These findings are also supported by Aryal *et al.*, 2022 who reported that mulching produced better yield attributes and yield and therefore conservation agriculture with residue retention seems better option for wheat cultivation.

Additionally, straw yield followed a similar pattern like grain yield, the maximum straw yield (Table 4) was recorded in WH 1142 (9852 kg/ha). Whereas, lowest straw yield was recorded in WH 1105 (5084 kg/ha). Similar pattern followed by varieties in terms of dry matter accumulation and LAI could be the reason behind this. The results are corroborated by the relevant literatures of Deshmukh *et al.* (2015); Kumari (2015).

Significantly the highest grain and straw yield was reported under (M_2) rice straw mulch (5061 and 8341 kg/ha, respectively) followed by (M_3) plastic mulch (4274 and 7676 kg/ha, respectively), while lowest was observed under (M_O) no mulch treatment (3555 and 6300 kg/ha, respectively). Although, the plant population was less under rice straw due to load of mulch, but later it was curtailed by producing more no. of tillers as reported by Ram *et al.* (2013). Hence, more grain and straw yield reported under rice straw mulch. Further, the grain and straw yield depends upon the plant height, dry matter accumulation, LAI and yield contributing parameters. The results are supported by the literatures of Humphreys *et al.* (2016); Mani *et al.* (2016); Akter *et al.* (2018); Dhaliwal *et al.* (2019); Javed *et al.* (2019) partially supported by Rummana *et al*. (2018). Subsequent absorption of stored soil moisture moderated the water status of plants, soil temperature and soil mechanical resistance, resulting in improved root development and grain yields (Pervaiz *et al*., 2009).

Table 4: Effect of application of different mulch materials on Grain yield (kg/ha), Straw yield (kg/ha) and Biological yield (kg/ha) of different wheat varieties.

Treatments	Grain yield (kg/ha)	Straw yield (kg/ha)	Biological yield (kg/ha)
Varieties			
V_1-WH 1142	5466	9852	15318
V_2- WH 1105	3477	5084	8561
V_3- HD 2967	5233	8701	13933
V_4- WH 1184	3889	6667	10556
V_5- HD 3086	3951	6948	10900
V_6- WH 1124	3764	7381	11145
SE(m)	81	115	163
CD (p=0.05)	233	332	470
Mulches			
M_1- No mulch	3555	6300	9855
M_2- Rice straw mulch @ 6t/ha	5061	8341	13402
M_3- Plastic mulch	4274	7676	11950
SE (m)	57	81	115
CD (p=0.05)	165	235	332

Biological yield: Biological yield is decided by growth parameters *viz.* plant height, LAI, dry weight of plant and partitioning of photosynthates. Similar pattern was also found in case of biological yield (kg/ha). The maximum biological yield was recorded in WH 1142 (15318 kg/ha) while minimum was recorded in WH 1105 (8561 kg/ha). The higher grain yield and straw yield in WH 1142 resulted in higher biological yield of this variety as mentioned in Table 4. These findings are similar with the studies of Deshmukh *et al.* (2015); Upadhyay *et al*. (2015); Verma (2015); Mani *et al.* (2016). Among different mulch materials, similar trend like other yield attributes was observed in case of biological yield (kg/ha). Biological yield is determined by various growth parameters *viz.,* LAI, dry matter accumulation and partitioning of photosynthates.

Soil chemical properties

NPK content in soil after harvesting. Among the varieties, the difference was non-significant with respect to nitrogen availability in soil after harvesting of wheat plants. Similar findings were discovered by Belete *et al*. (2018). Although, phosphorous and potassium availability varied significantly among all varieties under study. The maximum availability of phosphorous and potassium in soil after harvesting reported by HD 2967 and WH 1184, respectively, while lowest reported from WH 1184 and WH 1142, respectively. The reason might be that different varieties have different root characters some have ability to explore more soil nutrients than others. It depends on the genetic constitution of plants. The results have conformity with the findings of La Riva and Morrow (2010).

Availability of nitrogen, phosphorus and potassium after harvest of wheat plants was significantly influenced by application of different mulch treatments. After harvest, highest available nitrogen was recorded in (M_2) rice straw mulch (162.83 kg/ha) followed by (M_3) plastic mulch (156.98 kg/ha) and (M_1) no mulch treatment (154.00 kg/ha). The additional nitrogen was most likely derived from nitrogen fixation promoted by straw and plastic mulch as a consequence of increased root residue inputs to the soil, which results in enhanced water thermal conditions, soil microbial activity was dramatically boosted under mulching. This was indicated by increased in microbial count and extracellular enzyme activity related to nitrogen in the soil which were induced by nitrogen input, mulching duration and soil carbon status. This act as an energy supplement to heterotrophs and a carbon dioxide source for surface phototrophs (Mo *et al*., 2020).

Chaudhary *et al*. (2018); Ahmed *et al.* (2020) demonstrated via experimental trial increase in availability of phosphorus and potassium under mulch treatments due to availability of more soil moisture. Rice straw consists of 1.1 to 3.7 per cent potassium which are soluble in water and is quickly available to crop *via* soil. In this case, similar trend was followed in case of phosphorous and potassium availability in soil after harvest of wheat plants. The reason behind this is that organic mulch besides providing major and micro nutrients, also adds sufficient amount of humic substances to soil keeping the soil pH within favourable range which are stimulatory to the growth and development of plant resulting in quick mineralization and availability of nutrients not only for present crop but also for subsequent crops. Additionally, the increased phosphorus availability in the soil may be attributable to decreased iron and aluminium activity in the soil and decreased phosphorus fixation by iron and aluminium. Phosphorus availability improves as a result of persistent compounds of organic acids with iron and aluminium formed by the addition of organic matter *via* rice straw which lowers fixation (Brady, 2008).

Table 5: Effect of different mulch materials on NPK content (kg/ha) in soil after harvesting of different wheat varieties.

Treatments	Available Nitrogen (kg/ha)	Available P_2O_5 (kg/ha)	Available K_2O (kg/ha)
Pre-sowing	**186.20**	**16.47**	**348.80**
Varieties			
V_1- WH 1142	157.57	30.10	300.00
V_2- WH 1105	157.71	30.56	296.33
V_3- HD 2967	157.82	32.64	317.78
V_4- WH 1184	158.49	29.01	331.89
V_5- HD 3086	157.35	31.70	311.56
V_6- WH 1124	158.71	26.67	294.78
SE(m)	0.36	0.21	1.11
CD (p=0.05)	NS	0.59	3.21
Mulches			
M_1- No mulch	154.00	27.71	286.78
M_2- Rice straw mulch @ 6 t/ha	162.83	33.55	316.61
M_3- Plastic mulch	156.98	29.08	322.78
SE (m)	0.25	0.15	0.79
CD (p=0.05)	0.74	0.42	2.27

Soil moisture content: Soil moisture content (%) from different layers influenced significantly by different varieties and mulches as presented in Table 6**.** The data shown in Table 6 reveals that soil moisture content differs according to the choice of variety, stage of the crop and choice of mulch material. The soil moisture content after irrigation found maximum at 15-30 cm depth at 30, 60, 90 DAS and at harvest with respect to varieties and mulch material both. With increase in soil layer depth, soil moisture content increased Chaudhary *et al*. (2018). The reason behind this might be due to infiltration of water to deeper layer and further evaporation losses from the soil surface leads to more water content in subsoil than surface soil.

Among varieties, at 30 DAS, the maximum soil moisture content was reported from HD 2967 plots at depth of 0-15 and 15-30 cm, while lowest was reported from WH 1142 from both depths. However, At 60 DAS, WH 1142 reported maximum soil moisture content at depth of 0-15 and 15-30 cm, while lowest was reported from the plots of WH 1105. AT 90 DAS, 0-15 and 15-30 cm depth WH 1124 showed maximum soil moisture content, but trend was different for minimum soil moisture content. At harvest, the minimum soil moisture content at 0-15 and 15-30 cm depth was reported by WH 1142. This was due to to more WUE of this variety as a consequence of this, this variety reported maximum value with respect to yield attributes. Further, the variation among varieties due to the difference in crop architecture. Different varieties have different canopy architecture at different crop stages. Further, different varieties have different root characteristics. Root compositional attributes decide the variation in soil moisture extraction pattern as some can be grown under water restricted conditions than others (Manschadi *et al.*, 2008).

Different mulch material affected soil moisture content significantly during all crop stages except at 30 DAS. The maximum soil moisture content was found under (M_2) rice straw mulch at 30, 60, 90 DAS and at harvest at depth of 0-15 and 15-30 cm than other two treatments, while lowest reported from (M_1) no mulch treatment. These findings have similarity with the literature of Ahmad *et al.* (2015); Game *et al.* (2017); Bandopadhyay *et al.* (2018); Zhao *et al.* (2020). Furthermore, utilization of mulches as soil cover slows the rate of soil drying, resulting in water availability for longer time period during crop growth. Chaudhary *et al.* (2018). Moreover, with the increase in depth soil moisture content increases. This is probably due to storage of infiltrated water in deeper soil layer. Khurshid *et al.* (2006) reported similar findings by saying that mulching enhances the soil's ecological environment and also enhances its water content. Nevertheless, straw mulch conserves more water in the soil profile during the early development stage than no mulch. Following absorption of stored soil moisture maintains the plant's hydration status and soil temperature resulting in improved root development and grain yields (Rathore *et al.*, 1998).

Table 6: Effect of different mulch materials on soil moisture content (%) at 30, 60, 90 DAS and at harvest under different wheat varieties.

Treatments	30 DAS		60 DAS		90 DAS		AT Harvest	
Varieties	**0-15**	**15-30**	**0-15**	**15-30**	**0-15**	**15-30**	**0-15**	**15-30**
V_1-WH 1142	12.19	15.40	16.87	20.72	12.74	13.55	8.34	11.77
V_2- WH 1105	15.15	17.27	14.71	15.74	13.78	15.13	10.87	11.22
V_3-HD 2967	17.49	19.25	16.22	17.96	15.40	17.69	12.13	13.15
V_4- WH 1184	15.22	18.10	16.52	18.13	14.81	15.83	10.15	14.30
V_5- HD 3086	13.95	17.24	14.36	17.69	16.22	16.55	9.59	13.64
V_6- WH 1124	16.10	18.91	16.53	18.14	16.38	17.94	13.65	15.02
SE(m)	0.26	0.19	0.30	0.23	0.29	0.37	0.22	0.29
CD (p=0.05)	0.74	0.55	0.88	0.68	0.82	1.05	0.63	0.84
Mulches								
M_1- No mulch	14.75	16.91	14.81	17.08	13.17	14.32	8.68	11.67
M_2- Rice straw mulch @ 6 t/ha	15.20	18.99	17.37	19.97	16.65	18.36	13.24	14.84
M_3- Plastic mulch	15.09	17.19	15.43	17.14	14.85	15.67	10.44	13.05
SE (m)	0.18	0.14	0.22	0.17	0.20	0.26	0.15	0.21
CD (p=0.05)	NS	0.39	0.62	0.48	0.58	0.74	0.44	0.59

CONCLUSION AND FUTURE SCOPE

Utilization of mulch significantly improved the growth parameters in terms of, dry matter accumulation and LAI except plant population. Among wheat varieties, highest dry matter accumulation and LAI were registered in WH 1142. Crop sown under (M_2) rice straw mulch reported more soil moisture content, available soil nutrients than (M_3) plastic mulch and (M_1) no mulch. Sowing of wheat under (M_2) rice straw mulch resulted in significantly higher yield attributes resulting in 29.75 per cent higher grain yield than (M_1) no mulch. Among wheat varieties, there was significant variation in terms of yield attributes because of varietal characteristics. Highest grain yield (5466 kg/ha) and biological yield (15318 kg/ha) were obtained from WH 1142. Overall, it can be concluded from the study that growing variety WH 1142 with rice straw mulch @ 6 t ha^{-1} could help in improving productivity of wheat crop in an economic manner.

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Conflict of Interest. None.

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