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DRY MATTER AND STRAW YIELD IN WHEAT AS INFLUENCED BY PRECEDING CROPS, PLANTING METHODS AND IRRIGATION LEVELS

SURESH KUMAR*, A. S. DHINDWAL[1] AND R. K. ARYA

RDS Seed Farm
CCS Haryana Agricultural University,
Hisar-125 004 (Haryana), India
**(e-mail : sureshsilla@gmail.com)*

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SUMMARY

Dry matter and straw yield wheat succeeding mungbean and sorghum were evaluated under two planting methods and three irrigation levels during 2003-04 and 2004-05 at research farm of CCS Haryana Agricultural University, Hisar, Haryana (India). The treatments consisted of two preceding crops viz., sorghum as green fodder and moong as grain and two planting methods viz., conventional and zero-tillage in main plots and three irrigation levels viz., irrigation at CRI+IW/CPE of 0.5, 0.7 and 0.9 in sub-plots, replicated thrice. Total dry weight recorded at spike initiation, anthesis, milk and physiological maturity stages of wheat crop during both the crop seasons was substantially higher after moong than the sorghum. Wheat planted by zero tillage accumulated significantly higher total dry weight at all the growth stages during both the crop seasons compared to conventional tillage. The dry matter accumulation increased significantly with the increase in level of irrigation from irrigation at CRI+IW/CPE=0.5 to 0.9 during the first crop season, however, at spike initiation stage the dry matter accumulation was at par among the irrigation levels. Straw yield of wheat succeeding moong was significantly higher during the two crop seasons (7288 and 6856 kg/ha) as compared to that succeeding sorghum (6342 and 6561 kg/ha). Zero tillage in wheat produced significantly higher pooled straw yield (6969 kg/ha) as compared to conventional tillage (6555 kg/ha). Higher level of irrigation at CRI+IW/CPE=0.9 produced higher straw yield of wheat during both the crop seasons than lower levels of CRI+IW/CPE=0.5 and 0.7. Nitrogen content in wheat straw was higher succeeding moong than sorghum in both the crop seasons. Planting methods did not influence the N content in wheat straw during the first crop season, but in second crop season its content in wheat straw was higher under conventional tillage than zero tillage. Nitrogen content in straw was higher with lower level of irrigation at CRI+IW/CPE=0.5 than at higher levels of CRI+IW/CPE=0.7 and 0.9.

Key words : Wheat, zero-tillage, preceding crops, irrigation levels, dry matter accumulation, straw yield

India supports about 20 per cent of the world's livestock and 16.8 per cent human population with only 2.3 per cent of the world's geographical area. It is leader in cattle (16%) and buffalo (55%) population and has the world's second largest goat (20%) and fourth largest sheep (5%) population. At the national level, there is a short supply of about 38 per cent green fodder, especially during the summer season. Continuous supply of well balanced nutritive forage is essential to the milch animals for enhancing milk productivity (Meena *et al*., 2012). At the national level, there is a short supply of about 38 per cent green fodder, especially during the summer season. There is tremendous pressure of livestock on available feed and fodder, as land available for fodder production has been decreasing. Cereal straw constitutes the major component of dry fodder for the animals in our country. Wheat (*Triticum aestivum* L.) is the most important staple food in North-Western Indo-Gangetic Plains of India including Haryana and wheat straw is the principal feed in the green fodder limited conditions and it also constitutes major portion of animal feed along with the green fodder. Hence, dry matter and straw yield in wheat as influenced by preceding crops, planting methods and irrigation levels were evaluated.

[1]Department of Soil Science, CCS Haryana Agricultural University, Hisar.

MATERIALS AND METHODS

A field trial was conducted during two **rabi** seasons of 2003-04 and 2004-05 at research farm of CCS Haryana Agricultural University, Hisar, Haryana (India) situated at 29°10' N latitude and 75°46' E longitude. The texture of the experimental upper soil layer was sandy loam having basic infiltration rate of 4.2 mm/h. It contained 20.5 and 7.2 per cent moisture, on weight basis, at -0.03 and -1.5 MPa, respectively. The OC content was 0.38 per cent, low in available N, medium in P and high in K. The ground water table during the crop seasons fluctuated around 1.5 m. Two preceding crops viz., sorghum (*Sorghum bicolar* L.) as green fodder and moong (*Vigna radiata* L.) as grain, and two planting methods viz., conventional and zero-tillage in main plots were evaluated each under three irrigation levels viz., irrigation at CRI+IW/CPE of 0.5, 0.7 and 0.9 in sub plots. After the preceding **kharif** crops of moong and sorghum and a pre-sown irrigation, wheat cv. WH 711 was sown with conventional and zero tillage (zero-tillage seed-cum fertilizer drill) practices. To control weeds in zero-till plots, herbicide (Glyphosate @ 2.5 l/ha) was applied after the harvest of moong and sorghum. The other cultural practices followed were as per recommendations. Irrigations, as per treatments, were applied in individual plot by flooding and the depth was measured with the help of current meter. The IW/CPE ratios were calculated based on depth of irrigation water and the cumulative pan evaporation during the particular period. The dry weight of individual plant parts leaves, stem and spike and the total dry weight per m^2 were estimated at different crop growth stages. After harvesting the straw yield was worked out by subtracting the grain yield from total biological yield taken after sun drying for four days.

RESULTS AND DISCUSSION

Dry Matter Accumulation

Total dry weight recorded at spike initiation, anthesis, milk and physiological maturity stages of wheat crop during both the crop seasons was substantially higher after moong than the sorghum (Table 1). Its partitioning into leaves, stem and spike was also higher after moong than sorghum and followed the similar trend as that of total dry weight. These results are in accordance with those of Balyan (1997) and Kumar and Sharma (2000) who also reported that the dry matter per plant of wheat preceded by legume crop was higher as compared to other crops.

Wheat planted by zero tillage accumulated significantly higher total dry weight at all the growth stages during both the crop seasons compared to conventional tillage (Table 1). Similarly, partitioning of dry matter into leaves, stem and spike was higher in zero than conventional tillage. Increase in number of tillers, LAI and better nutrient and moisture availability under zero tillage have resulted in higher dry matter production and it's partitioning in different parts. However, Gangwar *et al*. (2004) reported higher dry matter accumulation in wheat under conventional than zero tillage.

The dry matter accumulation increased significantly with the increase in level of irrigation from irrigation at CRI+IW/CPE=0.5 to 0.9 during the first crop season. At spike initiation stage the dry matter accumulation was at par among the irrigation levels (Table 1). During the second crop season, the total dry matter of wheat crop and its partitioning into leaves, stem and spike at spike initiation, anthesis and milk stages was not influenced due to varying irrigation levels, but at the physiological maturity stage, the total and spike dry weight was found to be significantly higher under irrigation at CRI+IW/CPE=0.9 as compared to irrigation at CRI+IW/CPE=0.7 and 0.5. The leaf and stem dry weights under CRI+IW/CPE=0.9 were statistically higher than CRI+IW/CPE=0.5, but the difference between CRI+IW/CPE=0.7 and 0.5 was not marked. Chavan and Pawar (1988) also reported non-significant difference in dry matter accumulation in the initial growth stage under irrigation levels and more dry matter accumulation at higher irrigation level after flowering. Increase in irrigation levels resulted in higher number of tillers, higher LAI due to enhanced moisture and nutrient, which resulted in higher photosynthetic activity per unit area and hence more dry matter production. Deshmukh *et al*. (1993) also reported more dry matter production under higher irrigation levels as compared to lower ones, while Dubey and Sharma (1996) found IW/CPE of 0.9 as optimum for harvesting higher dry matter.

Straw Yield

Straw yield of wheat succeeding moong was significantly higher during the two crop seasons (7288 and 6856 kg/ha) as compared to that succeeding sorghum

TABLE 1
Dry matter and its partitioning (g/m^2) at various growth stages under different treatments

Treatment	Spike initiation				Anthesis				Milk stage				Physiological maturity			
	Leaf	Stem	Spike	Total	Leaf	Stem	Spike	Total	Leaf	Stem	Spike	Total	Leaf	Stem	Spike	Total
2003-04																
Preceding crops																
Moong	69.1	68.8	-	137.9	178.5	285.2	109.8	573.5	255.8	559.5	307.8	1123	269.7	613.4	354.7	1237.8
Sorghum	48.8	48.0	-	96.9	127.1	263.9	89.9	480.8	173.5	528.1	257.0	958.5	185.2	582.0	293.7	1060.9
C. D. (P=0.05)	1.2	0.9	-	2.2	4.0	6.6	4.0	12.8	5.6	6.3	8.7	8.9	5.9	NS	22.2	44.3
Planting methods																
CT	54.1	52.8	-	106.9	144.3	263.5	95.9	503.8	207.1	522.1	271.2	1000.4	218.5	588.8	309.2	1116.5
ZT	63.8	64.0	-	127.8	161.3	285.5	103.8	550.6	222.2	565.4	293.6	1081.2	236.4	606.6	339.2	1182.2
C. D. (P=0.05)	1.2	0.9	-	2.2	4.0	6.6	4.0	12.8	5.6	6.3	8.7	8.9	5.9	NS	22.2	44.3
Irrigation at CRI+IW/CPE ratio																
0.5	58.5	58.7	-	117.2	135.5	241.3	103.2	480.0	188.0	477.7	291.9	957.7	203.8	529.2	287.8	1020.8
0.7	59.5	57.6	-	117.1	157.2	276.8	100.1	534.1	217.3	548.4	283.1	1048.8	228.6	591.8	331.3	1151.6
0.9	59.0	58.9	-	117.9	165.8	305.5	96.2	567.4	238.6	605.2	272.1	1115.9	249.9	672.1	353.6	1275.7
C. D. (P=0.05)	NS	NS	-	NS	7.8	10.6	NS	18.1	10.3	10.6	10	12.6	4.9	27.0	11.2	62.6
2004-05																
Preceding crops																
Moong	63.8	63.5	-	127.3	156.9	255.3	117.4	529.6	226.3	586.2	317	1129.5	236.6	595.0	373.6	1205.2
Sorghum	46.2	45.5	-	91.7	111.4	208.1	95.8	415.3	176.2	528.5	290.2	994.9	184.9	546.5	340.4	1071.8
C. D. (P=0.05)	3.2	4.7	-	6.3	8.7	14.5	6.0	15.5	10.1	24.4	16.6	40.3	8.5	20.0	13.7	28.3
Planting methods																
CT	48.2	47.0	-	95.2	124.2	214.0	100.5	438.8	188.5	535.2	288.5	1012.2	197.8	544.0	337.3	1079.1
ZT	61.8	62.0	-	123.8	144.1	249.4	112.7	506.1	214.0	579.5	318.8	1112.3	223.6	597.5	376.7	1197.9
C. D. (P=0.05)	3.2	4.7		6.3	8.7	14.5	6.0	15.5	10.1	24.4	16.6	40.3	8.5	20.0	13.7	28.3
Irrigation at CRI+IW/CPE																
0.5	54.5	54.7	-	109.2	134.6	229.6	109.9	474.1	201.2	545.0	295.9	1042.1	194.3	542.5	314.7	1051.5
0.7	55.9	54.3	-	110.2	133.4	232.4	106.7	472.5	203.6	560.0	308.9	1072.5	216.3	572.0	364.8	1153.2
0.9	54.6	54.5	-	109.1	134.5	233.1	103.2	470.8	198.9	567.0	306.1	1072.0	221.6	597.7	391.5	1210.9
C. D. (P=0.05)	NS	NS	-	NS	NS	NS	NS	NS	NS	NS	NS	NS	13.0	26.8	15.5	33.6

NS–Not Significant.

TABLE 2
Straw yield and its nitrogen content in wheat under different treatments

Treatment	Straw yield (kg/ha)			Nitrogen content (%)	
	2003-04	2004-05	Pooled	2003-04	2004-05
Preceding crops					
Moong	7288	6856	7072	0.50	0.54
Sorghum	6342	6561	6452	0.45	0.50
C. D. (P=0.05)	445	207	264	0.02	0.02
Planting methods					
CT	6650	6460	6555	0.47	0.54
ZT	6980	6958	6969	0.47	0.51
C. D. (P=0.05)	NS	207	264	NS	0.02
Irrigation at CRI+IW/CPE					
0.5	6000	6254	6127	0.50	0.55
0.7	6733	6820	6776	0.47	0.52
0.9	7712	7053	7382	0.46	0.50
C. D. (P=0.05)	483	199	264	0.02	0.03

NS–Not Significant.

(6342 and 6561 kg/ha) (Table 2). Pooled straw yield of wheat (6856 kg/ha) for the two seasons was also significantly higher succeeding moong than sorghum (6452 kg/ha). Kumar and Sharma (2000) also observed better wheat straw yield after legume crops compared to cereals due to improved physical, chemical and microbiological properties of soil owing to enrichment of soil through biological nitrogen fixation, less removal of nutrients and higher availability of soil N and P and their uptake by succeeding wheat crop (Singh *et al*., 2003).

Straw yield did not differ statistically under planting methods i. e. conventional (6650 kg/ha) and zero tillage (6980 kg/ha) during the first crop season. However, during the second crop season, zero till wheat produced significantly higher straw yield (6958 kg/ha) as compared to conventional (6460 kg/ha). Zero tillage in wheat produced significantly higher pooled straw yield (6969 kg/ha) as compared to conventional tillage (6555 kg/ha). Increased moisture availability (Mahey *et al*., 2002) and escape from terminal heat due to temperature moderation (Yadav *et al*., 2005) caused better growth and increased straw yield under zero tillage. Similar increase in straw yield under zero tillage was reported by Kakkar *et al*. (2005).

Among the irrigation levels higher level of irrigation at CRI+IW/CPE=0.9 produced higher straw yield of wheat during both the crop seasons than lower levels of CRI+IW/CPE=0.5 and 0.7 (Table 2). Pooled straw yield of two years was highest (7382 kg/ha) under irrigation at CRI+IW/CPE=0.9 and declined significantly with successive decrease in irrigation level. Lower grain yield under lower irrigation levels can be attributed to poor growth due to reduced stomatal activities (Yang *et al*., 2004).

Nitrogen Content in Straw

Nitrogen content in wheat straw was higher succeeding moong than sorghum in both the crop seasons (Table 2). Increase in N content succeeding a legume crop was also reported by Balyan (1997) and Singh *et al*. (2003) owing to enrichment of soil through biological nitrogen fixation, less removal of N and its higher availability in soil N and its uptake by succeeding wheat crop. Planting methods did not influence the N content in wheat straw during the first crop season, but in second crop season its content in wheat straw was higher under conventional tillage than zero tillage. Similar N contents in wheat under zero tillage and conventional tillage were also reported by Kumar *et al*. (2005). Nitrogen content in straw was higher with lower level of irrigation at CRI+IW/CPE=0.5 than at higher levels of CRI+IW/CPE=0.7 and 0.9. Rao and Rao (1986) and Sharma *et al*. (1990) also observed that with increasing levels of irrigation from 0.6 to 1.2 IW/CPE, the N content decreased in wheat straw.

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