Effect of establishment methods and weed-control measures on Broad leaf weeds, yield attributes and harvest index of wheat (Triticum aestivum L.)

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Abstract— *A field experiment was conducted during rabi season of 2013-2014 at Pantnagar, District, Udham Singh Nagar (Uttarakhand) to assess the effect of weed-control measures on Broad leaf weeds, nutrient uptake, yield attributes and harvest index under different establishment methods. ZTW recorded significantly higher total dry matter of BLWs over CTW and RTW at 60, 90 DAS and at maturity stage. Clodinafop-propargyl @ 60 g/ha recorded the maximum dry matter which was significantly higher over weedy and two hand weedings at 90 DAS and at maturity stage.. Number of grains per spike exhibited non-significant variation owing to establishment methods. Ready mix of clodinafop-propargyl + MSM @ 64 g/ha and clodinafop-propargyl @ 60 g/ha produced maximum number of grains per spike. Highest harvest index value was obtained under CTW which was at par with ZTW.The highest harvest index value was obtained with crop given clodinafop-propargyl @ 60 g/ha.*

Keywords— zero tillage, conventional tillage, roto till seed drill, wheat, broad leaf weeds, yield attributes.

I. INTRODUCTION

Wheat (Triticum aestivum) is the world's most widely cultivated food crop and in India it is second important staple food, rice being the first. The exhaustive rice wheat cropping system (RWCS) practiced with conventional tillage (CT) has resulted in lower marginal returns (Ladha et al., 2000), delay in wheat sowing and reduces wheat yield (Gangwar et al., 2005). Whereas zero tillage reduces production costs, saves water, increases soil organic matter, prevents soil erosion, mitigates greenhouse gases from the soil, improves air quality, protects wildlife habitat and biodiversity, improves production and ensures environmental safety (Gupta et al., 2002; Khan et al., 2004). Weeds cause yield reduction to the tune of 15 to 50 % or sometime more depending upon the weed density and weed flora (Jat et al., 2003). Weeds can be effectively controlled with the use of selective herbicides. As a result of this, different herbicides like clodinafop-propargyl and metsulfuron methyl have been tested. The actions of these herbicides on weeds have been tested under conventional method of wheat sowing but new techniques of establishment of wheat revealed different types of weed flora with different density of weeds and their management practices are also different to the conventional system.

II. MATERIALS AND METHODS

A field experiment was conducted during rabi season of 2013-2014 in the D-2 block of Norman E. Borlaug, Crop Research Centre (CRC) of G.B Pant University of Agriculture and Technology, Pantnagar, District, Udham Singh Nagar (Uttarakhand). The soil was silty clay loam, with pH 7.2, medium in organic carbon (0.70%) and available nitrogen (217.5 kg/ha) and medium in available phosphorus (21.9 kg/ha) and available potash (190.3 kg/ha). Three establishment methods viz., zero tillage with rice straw 3 t/ha (50 % of general straw yield), roto till seed drill and conventional tillage in the main plots and four weed management practices viz., weedy check, two hand weedings (30 and 60 days after sowing), clodinafop-propargyl @ 60 g/ha and ready mix of clodinafop-propargyl 15% + metsulfuron methyl 1% @ 64 g/ha in the subplots were tested in split plot design with 3 replications. The experimental wheat crop was fertilized uniformly with 150:60:40 kg/ha of N, P and K, respectively. The variety PBW 502 was sown with a seed rate of 100kg/ha. on 14 november,2013. In case of zero tillage, zero till ferti seed drill was used for sowing. Under roto tillage, the sowing was done with the roto till seed drill and in conventional system, general wheat seed drill was used for sowing. Herbicides were sprayed in the aqueous medium using 500 litres of water per hectare with the help of Maruti foot sprayer fitted with a flat fan nozzle. Weeds falling within the quadrate (species wise) were cut close to the ground surface and sun dried then kept in hot air oven at 70±2 °C till constant dry weight. Dry matter of weeds (species wise) was recorded and expressed in gram per metre square. The number of spikes was counted from the observation area of two metre row length marked for shoot count and was expressed as number of spikes per metre square. Ten spikes were sampled continuously for recording the following observations in each plot. Length of ten spikes was measured in cm and average was considered as spike length and expressed as cm per spike.

The sampled spikes were manually threshed and number of total grains was counted manually. The number of grains per spike was computed by taking the average of all ten spikes. The number of the total grains from the sampled spikes was counted manually and the grain weight of thousand grains was computed and expressed in grams (g).

Harvest index is the ratio of economic part of crop to total dry weight of the crop expressed in percentage and calculated by using following formula.

$$\mathrm{HI} = \frac{\mathrm{Economic\,Yield}}{\mathrm{Biological\,Yield}} \times 100$$

III. RESULTS AND DISCUSSION

Dry matter accumulation of total broad leaf weeds (BLWs)

Dry matter accumulation of BLWs was significantly influenced by the establishment methods of wheat. ZTW recorded significantly higher total dry matter of BLWs over CTW and RTW at 60, 90 DAS and at maturity stage. Substantially low density of Phalaris minor under ZTW was responsible for the dominance of BLWs in ZTW. Bhardwaj et al. (2004) also reported the similar finding. Weed management practices also influenced the dry matter of BLWs significantly. Clodinafop-propargyl @ 60 g/ha recorded the maximum dry matter which was significantly higher over weedy and two hand weedings at 90 DAS and at maturity stage. This is attributed to the ineffectiveness of clodinafop-propargyl @ 60 g/ha against BLWs. Mohammed et al. (2007), Khalid et al. (2009) also reported that clodinafop-propargyl works against only grassy weeds. Weedy plots at 60 DAS recorded significantly higher dry matter production of BLWs over two hand weedings and clodinafop-propargyl @ 60 g/ha. Ready mix of clodinafop-propargyl+MSM @ 64 g/ha recorded complete reduction of dry matter of BLWs as it is effective against BLWs as well. Yadav et al. (2009) also reported the effectiveness of ready mix of clodinafop-propargyl+MSM @ 64 g/ha against BLWs.

Number of spikes/m2

Establishment methods of wheat did not affect spikes per metre square significantly. Spikes per square metre were highest under CTW followed by ZTW and lowest in RTW, although, the difference was not significant. All the weed management practices produced significantly higher number of spike per square metre over weedy plot. Ready mix of clodinafop-propargyl + MSM @ 64 g/ha recorded highest number of spike per square metre which was at par with two hand weedings and significantly higher over clodinafop-propargyl @ 60 g/ha Singh (2013) also reported the similar findings. The highest number of spikes per meter square under ready mix of clodinafop-propargyl + MSM @ 64 g/ha might be due to effective control of grassy as well as BLWs which reduced the crop weed competition and enhanced the number of effective tillers and spikes as well. Chhokar and Malik (2002); Bharat et al. (2010) also concluded that metsulfuron and clodinafop were effective against broad-leaved and grassy weeds, respectively.

Spike length

Differences in spike length due to wheat establishment methods as well as weed management practices were found non-significant. However, longest spike length has been recorded in case of ZTW and shortest in RTW. Among different weed management practices, spike length was longest in case of clodinafop-propargyl @ 60 g/ha whereas, it was shortest under weedy check.

Number of grains per spike

Number of grains per spike exhibited non-significant variation owing to wheat establishment methods, whereas; weed management practices influenced number of grains per spike significantly. Numerically, CTW recorded maximum number of grains per spike while minimum was found in case of RTW. All the weed control measures produced significantly higher number of grains per spike over weedy plot. Ready mix of clodinafop-propargyl + MSM @ 64 g/ha among the various weed control measures produced maximum number of grains per spike which was at par with clodinafop-propargyl @ 60 g/ha and significantly higher than two hand weedings. Singh (2013) also reported the similar findings. It might be due to better source to sink relationship which resulted due to less crop weed competition as ready mix of clodinafop-propargyl + MSM @ 64 g/ha controlled the total weed population.

TABLE 1
EFFECT OF TREATMENTS ON DRY MATTER (G/M2) OF TOTAL BROAD LEAF WEEDS AT VARIOUS STAGES OF THE CROP GROWTH

Treatments	Total BLWs dry matter accumulation		
	60 DAS	90 DAS	At maturity
A. Establishment method			
Zero tilled wheat	1.58(6.48)	1.42(7.54)	1.53(8.42)
Conventional tilled wheat	1.27(4.12)	1.23(5.06)	1.26(4.07)
Roto till drilled wheat	1.45(5.58)	1.22(4.70)	0.99(2.85)
SEm±	0.03	0.02	0.03
CD (5%)	0.11	0.08	0.12
B. Weed management practices			
Weedy	2.54(11.99)	2.11(7.50)	2.14(7.77)
Two hand weeding	1.18(2.33)	0.32(0.40)	0.50(0.70)
Clodinafop-propargyl @60g/ha	2.01(7.24)	2.73(15.16)	2.40(11.99)
Ready mix of Clodinafop-propargyl + MSM @ 64 g/ha	0.00	0.00	0.00
SEm±	0.03	0.04	0.03
CD (5%)	0.09	0.13	0.09

TABLE 2
EFFECT OF TREATMENTS ON YIELD ATTRIBUTING CHARACTERS AND HARVEST INDEX OF CROP AS AFFECTED BY VARIOUS TREATMENTS

Treatments	No. of spike/m^2	Spike length (cm)	Number of grains/spike	1000-grain weight (g)	Harvest index
A. Establishment method					
Zero tilled wheat	341	14.35	40	41.41	35.85
Conventional tilled wheat	389	13.61	42	40.27	38.17
Roto till drilled wheat	313	13.51	39	40.92	32.75
SEm±	18.93	0.26	0.52	0.69	0.95
CD (5%)	NS	NS	NS	NS	3.81
B. Weed management practices					
Weedy	232	13.36	35	38.39	27.73
Two hand weeding	380	14.07	39	41.32	38.19
Clodinafop-propargyl @60g/ha	372	14.19	43	40.94	38.82
Ready mix of Clodinafop-propargyl + MSM @ 64 g/ha	405	13.68	45	42.83	37.61
SEm±	10.49	0.25	1.51	0.70	1.01
CD (5%)	31	NS	5.0	2.08	3.02

1000-grain weight

Variation in thousand grain weight attributed to wheat establishment methods was found non-significant. It is obvious that all weed management practices provided significantly better condition than unweeded control as to accumulate the dry matter in grains. The data further indicated that crop given ready mix of clodinafop-propargyl + MSM @ 64 g/ha had highest test weight of wheat which was at par with two hand weedings and clodinafop-propargyl @ 60 g/ha. This finding confirms the results of Singh (2013).

Harvest index

Differences in harvest index due to various wheat establishment methods were found significant. Highest harvest index value was obtained under CTW being at par with ZTW and significantly higher than RTW. All the weed control measures applied plots produced significantly higher harvest index value than weedy check. The highest harvest index value was obtained with crop given clodinafop-propargyl @ 60 g/ha which was at par with two hand weedings and ready mix of clodinafop-propargyl + MSM @ 64 g/ha.

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