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Integration of chemical and cultural methods for weed management in wheat

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ABSTRACT : An experiment was laid out to study the effect of integrated weed management practices for weed management in wheat variety Kalyansona during *Rabi* seasons of the year 2013 – 2014 in Randomized Block Design at Central Research Station of Orissa University of Agriculture and Technology, Bhubaneswar ,Odisha. The experiment comprised of twelve weed management practices as treatments *i.e.* pendimethalin @1.0 kg ha^{-1}(2 DAS), metribuzin @ 0.3 kg ha^{-1}(2 DAS), metsulfuron @ 0.02 kg ha^{-1}(25 DAS), pendimethalin + One HW(25 DAS), pendimethalin + 2, 4-D EE @ 0.5 kg ha^{-1} (25 DAS), metsulfuron + One HW (25 DAS), metsulfuron + 2, 4-D EE @ 0.5 kg ha^{-1} (25 DAS), pendimethalin + metsulfuron (25 DAS), metribuzin + metsulfuron (25 DAS), 2, 4-D @ 0.5 kg ha^{-1} (25 DAS), Two hand weeding at 25 and 45 DAS and Unweeded control. Wheat was sown at row spacing 20 cm x 5 cm on flat beds. The results showed that when pendimethalin was applied along with one hand weeding at 25 days after sowing had the highest weed control efficiency percentage (95.35%) and also the crop gave the highest grain yield *i.e.* 2784 kg ha^{-1} followed by two hand weeding at 25 and 45 DAS (grain yield 2677 kg ha^{-1}), but in this case the weed control efficiency percentage was very low (17.44%). Uncontrolled weed growth throughout the crop growth caused a yield reduction of 29.12 to 62.14 per cent. It is concluded that pendimethalin + one hand weeding remarkably reduced the weed dry matter resulted in increase in weed control efficiency. The same treatment proved its superiority in increasing all yield attributing factors along with grain yield of wheat indicating the most effective integrated weed management practice for wheat.

KEY WORDS : Integrated methods, Herbicides, Wheat, Yield, Weed control efficiency

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India is the second largest producer of wheat in the world contributing about (94.88) million tonnes of grains with productivity of 2.98 t ha^{-1} from the area of 31.5 million hectares (Chhokar *et al.*, 2012). India will need to produce about 109 million tonnes of wheat by 2020 with the annual rate of increase in production of about 2.28 per cent against the present rate of annual increase to about 1 per cent (Mishra *et al*., 2006). In Odisha the non-traditional region for wheat where the area and production is very low. But the productivity of about 0.042 t ha^{-1} explores its possibility of cultivation and to increase the yield level, at par with other non-traditional wheat growing belt of India in order to meet the substantial food demand. Of several constraints wheat crop usually suffers from stress created by weeds through competition for water, nutrients, space and sunlight (Anderson, 1983) along with interference caused by releasing toxic substances into the rhizosphere of the crop plants (Rice, 1984). Apart from increasing the production cost, they also intensify the disease and insect pest

problem by serving as alternative hosts (Marwat *et al.*, 2008). Weeds cause yield reduction upto 70 per cent in some wheat growing areas (Tanner and Giref, 1991). To properly address the weed problem in wheat, there is a dire need of developing a package of weed control technology for the wheat growers (Marwat *et al.*, 2008).

The weed flora associated with wheat in Odisha is totally different from that of India. The reduction in grain yield of wheat due to weed competition is to the tune of 28 to 53 per cent in India (Govindra *et al*., 2002) and 34.5 per cent in Odisha. To bridge the gap between potential and actual yield levels of production, an effective weed management practices has to be found out. There is need to reduce weed infestation during the critical competitive period and to devise a cost effective weed management practice.

Hand weeding is laborious, time consuming, energy intensive and only possible on small scale and effective on annual weeds. Raising cost of labour and their non-availability lead to the search for alternative methods such as herbicide use either alone or in combination with hand weeding. The challenge for weed scientists is to develop innovative, effective, economical and environmentally safe IWM systems that can be integrated into current and future cropping systems to bring a more diverse and integrated approach to weed management.

Considering the above facts in mind an attempt has been made in the present investigation to devise the most effective and economical method of integrated weed management in non-traditional wheat growing belt of Odisha.

RESEARCH PROCEDURE

The experiment was conducted at Central Research Station of Orissa University of Agriculture and Technology, Bhubaneswar, Odisha for *Rabi* seasons in 2013-14 in Randomized Block Design with twelve treatments replicated three times. The experimental site was located at 20.15^0 N latitudes and 85.53^0 E longitudes with average annual rainfall of 1520 mm. The soil of experimental field was medium deep with pH 5.1 and 257.0 kg, 26.3 kg and 152.8 kg ha^{-1} available N, P_2O_5 and K_2O, respectively. The details of treatments are given in Table 1. Bold and healthy seeds of wheat were selected and treated with captan at the rate of 2 g kg^{-1} of seed. Wheat variety 'Kalyansona' was sown in first fortnight of December during 2013-14 with plant spacing of 20 cm x 5 cm on flat beds. Nitrogen, phosphorous and potassium were applied at the rate of 60: 30 : 30 kg N, P_2O_5, and K_2O ha^{-1} in the form of urea, single super phosphate and muriate of potash, respectively. The entire quantity of P and K fertilizer along with 50 per cent N fertilizer was applied at the time of sowing and rest 50 per cent N at 25 DAS. The inter cultivation and hand weeding were carried out as per the treatment details. Randomly five plants were selected from each plot and regular biometric observations of crop and weed parameters were recorded from 30 DAS up to harvest. Weed density (no./m^2) and dry weight of weeds (g/m^2) were recorded by putting a quadrate of 0.25m^2 at two random spots in each plot. Weed control efficiency and weed index was calculated by standard formulae. For economic study, prevailing market price was used for different outputs and inputs.

RESEARCH ANALYSIS AND REASONING

The findings of the present study as well as relevant discussion have been presented under following heads :

Effect on weeds :

Wheat crop was infested with five grassy weed, one sedge and six broad leaf weeds. The aerobic condition favoured the growth of grassy weeds leading to maximum occurrence of grassy weeds. The population of grassy weeds ranged from 69.49 to 74.77 per cent at different growth stages of the crop. *Digitaria ciliaris* was found to be the dominant weed among the grasses. Dicot weeds infestation was observed to be the extent of 25.23 to 30.51 per cent. The most prevalent broad leaf weed was *Cleome viscosa* in the experimental site. The weeds flrora in Bhubaneswar, Orissa was totally different from that of the weed flora of the traditional wheat growing region of India.

The data on total weed dry weight as presented in Table 1 indicate that weed control treatments resulted in decrease in weed dry weight compared with unweeded check. Weed dry weight in pendimethalin + one hand weeding (HW) treatment was minimum through out the crop growth stages. Lower weed dry mass in pendimethalin + one HW plot is due to slower pace of growth of first flush of weeds at 25 days after sowing and thereafter emergence of new flush of weeds could not attain the full growth under shade of the crop canopy. It is in conformity with the finding of Pandey *et al.* (2012).

Pendimethalin was found at par with two hand weeding treatment in depressing the weed dry matter accumulation at all the crop development stage. The higher bioefficacy of pendimethalin against the weeds in wheat is supported by the findings of Jat *et al*. (2010).

The weed control efficiency (WCE) indicates the comparative magnitude of reduction in weed dry matter by different weed control treatments. The greater WCE was recorded with pendimethalin + One HW at 25 DAS followed by application of pendimethalin alone (Table 1). This is possible due to depletion of weed dry weight resulted in increase in WCE. Similar favourable effect due to application of pendimethalin was observed by different worker (Jat *et al.*, 2009).

Effect on crop :

The magnitude of yield attributes like productive panicles per m^2, panicle length, number of grains $panicle^{-1}$ and 1000 grain weight contributes directly in increase in grain yield. Yield attributes were significantly influenced by weed control treatments (Table 1). Application of metsulfuron + one HW at 25 DAS promoted all the yield components in wheat. Pendimethalin @ 1.0 kg/ha gave the next best result. The improvement in yield parameters due to application of metsulfuron + one HW at 25 DAS and pendimethalin attributed to reduction in competitiveness of weeds with the crop for the desired inputs like nutrient, moisture, light and space which ultimately provided better environment for crop growth and development. It is in conformity with the findings of Kanojia and Nepalia (2006) and Jat *et al*. (2009).

Data presented in Table 1 indicated that weed control treatments significantly augmented the grain yield of wheat. Pre-emergence application of pendimethalin @ 1 kg ha^{-1} + two HW produced the maximum grain yield.

Table 1: Effect of weed control treatments on weed dry weight, weed control efficiency, yield attributes, grain yield and weed index of wheat

Treatments	Dry weight of weed g m^{-2}			Weed control efficiency(%)			Panicles m^{-2}	Panicle length (cm)	Fertile grains $panicle^{-1}$	Test weight (g)	Grain yield (kg ha^{-1})	Weed index (%)
	30 DAS	60 DAS	90 DAS	30 DAS	60 DAS	90 DAS						
Pendimethalin @1.0 kg ha^{-1}(2 DAS)	4.66	11.71	11	73.39	79.15	87.21	323.33	10.73	32.67	42.51	2365	15.05
Metribuzin @ 0.3 kg ha^{-1}(2 DAS)	1.75	36.45	63	90.01	35.08	26.74	285	10.00	29.67	38.90	2333	16.20
Metsulfuron @ 0.02 kg ha^{-1}(25 DAS)	1.00	18.29	24	94.29	67.43	72.09	288	10.23	33.33	39.91	2284	17.96
Pendimethalin + One HW(25 DAS)	0.77	3.59	4	95.60	93.61	95.35	295.67	10.83	32.00	39.79	2784	0.00
Pendimethalin + 2, 4-D EE @ 0.5 kg ha^{-1} (25 DAS)	6.58	10.37	6	62.42	81.53	93.02	313.67	11.60	33.00	36.88	2415	13.25
Metsulfuron + One HW (25 DAS)	4.98	18.67	19	71.56	66.75	77.91	335	11.40	34.67	41.84	2219	20.29
Metsulfuron + 2, 4-D EE @ 0.5 kg ha^{-1} (25 DAS)	1.21	64.09	63	93.09	14.14	26.74	315.33	11.37	26.67	38.86	2255	19.00
Pendimethalin + Metsulfuron(25 DAS)	0.97	9.73	14	94.46	82.67	83.72	323	9.23	31.67	42.17	2200	20.98
Metribuzin + Metsulfuron(25 DAS)	5.28	54.29	66	69.85	3.31	23.26	315	11.17	28.67	40.17	2241	19.50
2, 4-D @ 0.5 kg ha^{-1} (25 DAS)	3.67	48.00	80	79.04	14.51	6.98	309.67	11.17	30.33	39.39	2217	20.37
Two hand weeding at 25 and 45 DAS	4.89	45.50	71	72.07	18.97	17.44	294.67	11.47	32.33	40.51	2677	3.84
Unweeded control	17.51	56.15	86	-	-	-	278	8.13	26.2	23.39	1717	38.33
S.E.±	2.00	5.08	3	-	-	-	5.52	0.63	1.55	1.74	117	-
C.D.	5.85	14.91	9	-	-	-	16.19	1.85	4.54	5.12	342	-

DAS-Days after sowing

Hand weeding treatment did not differ significantly from the pendimethalin. Higher yields were attributed due to increase in growth and yield parameters thus, favoured accumulation of more sink which ultimately increased the yield. it is in agreement with findings of Kaur *et al*. (2007) and Jat *et al*. (2010). The use of pendimethalin controls the weeds at early stage of crop growth and maintains relatively low weed infestation till the harvest of crop and influenced the crop growth, more nutrient uptake and subsequently increases the grain yield. It is in agreement with the views of Jat *et al*. (2010). Maximum reduction in yield upto 38.33 per cent was observed under no weeding situation. Hand weeding treatment registered the minimum yield reduction value of 3.84 per cent. It is in line with respect to the findings of many workers (Kumar *et al*,. 2011; Singh *et al*., 2008 and Chopra and Chopra, 2008).

Conclusion :

Pendimethalin + one hand weeding remarkably reduced the weed dry matter resulted in increase in weed control efficiency. The same treatment proved its superiority in increasing all yield attributing factors along with grain yield of wheat indicating the most effective integrated weed management practice for wheat.

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