Original Research Article

Nutrient and water use efficiency, nutrient uptake and yield of Rice as influenced by fertigation levels and weeds management practices

ABSTRACT

A field experiment was conducted at AICRP on Weed Management Research Farm, Department of Agronomy, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola during *kharif* 2020-21. The experiment was laid out in split plot design with three replications and twenty treatment combinations having four different fertigation levels and five weed management practices. Experiment results revealed that, maximum rice grain yield (5103 $kgha^{-1}$), straw yield (7268 $kgha^{-1}$) and harvest index (41.25%) were substantially enhanced by drip fertigation with 125% RDNK in 5 splits than lower fertigation levels (75 and 100 per cent) and over conventional soil application with 100 per cent RDF. Nutrient use efficiency (NUE) was found better in drip fertigation at 75 per cent recommended dose of N and K per ha as compared to conventional soil application of fertilizers in rice crop. Among the herbicides, directed spray of Pretilachlor + Pyrazosulfuron Ethyl @ 0.615 a.i. $kgha^{-1}$ PE *fb.* Bispyribac sodium @ 0.025 a.i $kgha^{-1}$ at 25 DAS resulted in maximum rice grain yield (5231 $kgha^{-1}$) and also total nutrient uptake by crop and water use efficiency indicating the feasibility of using herbicides for effective weed management in rice and for enhancing NUE and WUE. The drip fertigation at 125% RDNK in 5 splits registered maximum GMR (₹120353 ha^{-1}), NMR (₹72924 NUE and WUE. The drip fertigation at 125% RDNK in 5 splits registered maximum GMR (₹120353 ha^{-1}) and B:C ratio (2.54). The herbicidal application of Pretilachlor + Pyrazosulfuron Ethyl 0.615 kgha-1 PE fb. Bispyribac sodium 0.025 $kgha^{-1}$ at 25 DAS registered maximum GMR (₹128755 ha^{-1}), NMR (₹81412ha^{-1}) and B:C ratio (2.72) among all herbicidal treatments, indicating the feasibility of using herbicides for effective weed management in rice.

Key Words: *Drip, Fertigation, Weed management practices, Nutrient uptake, Aerobic rice, WUE, Nutrient Use efficiency*

1.INTRODUCTION

Rice (*Oryza sativa*) is the most important cereal food crop in the world. It is the staple food for more than half of the world's population. In India rice was grown on 46 mha with production of 104.99 mt in the year 2022-23. Rice develops well in water, but recent developments demonstrate that rice can also be grown in dry soils under non-flooded conditions called "Aerobic rice". Aerobic rice cultivation saves water input and increases water productivity by reducing water use during land preparation and limiting seepage, percolation and evaporation. (Peng *et al*., 2012). [1]. Hence there is a need to develop and popularize innovative water saving technologies to "produce more rice crop from every drop" for a given specific locations. The injudicious use of irrigation water and improper weed management practices are the important reasons of low productivity of rice in India. Adoption of micro irrigation might help in increasing the irrigated area, productivity of crops and water use efficiency (Sivanappan, 2004) [2]. Soman (2018) [3] reported that drip-fertigation offers clear advantage for increasing the productivity of rice with low water consumption in drip irrigation as compared to flood. Fertigation system assures precise application of nutrients through use of water-soluble fertilizers which are made available at the root zone along with water for its direct absorption by the crop. Drip fertigation significantly influenced the growth, yield, water productivity and nutrient use efficiency (NUE) in aerobic rice (Kombali *et al.,*2016).[4] In fertigation methods, fertilizer use efficiency can increased upto 80 to 90 per cent.

Fertilizer application in wetland rice farming done manually through the soil application in split doses is imprecise and causes problems such as fluctuating nutrient supply and uneven fertilizer spread. This leads to various losses of nutrients under submerged cultivation. Besides loss of water and fertilizers through seepage and percolation, impounding water in paddy fields has an important environmental impact by contributing to global warming through considerable emission of methane. For effective weed management, improved weed control practices that include chemical weed control with newer formulations and herbicide mixtures and integrated cultivation need to be developed and refined. Malik *et al*. (2021) [5] reported 57 % losses respectively due to weeds in rice in India. Addressing these issues requires an integrated approach to soil water-plant-nutrient management at the plant rooting zone. One of these technologies is fertigation, which is the direct application of water and nutrients to plants through a drip irrigation system. The introduction of simultaneous micro irrigation and fertilizer application (fertigation) opens new possibilities for controlling water and nutrient supplies to crops besides maintaining the desired concentration and distribution of nutrients and water into the soil. Drip fertigation offers the scope to increase the productivity of crops per unit land, time and input use in crop production. The hypothesis is that weeds can be controlled efficiently having no adverse effect on soil beneficial microorganisms and yield can be maintained at a lower rate of input practice by improving the weed management strategy. Introduction of new herbicides, chemical weed control with pre-mix combination of herbicide may result in effective weed control in rice. With this background, an effort was made to assess the suitability of split application of nutrients through fertigation and weed management practices on nutrient and water use efficiency, nutrient uptake and yield of Rice

2. MATERIALS AND METHODS

A field investigation entitled "Nutrient and water use efficiency, nutrient uptake and yield of Rice as influenced by fertigation levels and weeds management practices" was conducted at AICRP on Weed management farm, Department of Agronomy, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola during *kharif*, 2020-21 with an objective to assess the suitability of split application of nutrients through fertigation and weed management practices on rice yield, water and nutrient use efficiency and nutrient uptake in rice. The experiment was laid out in split plot design with three replications with 20 treatment combinations having 4 different fertigation levels and 5 weed management practices. The main plot treatments comprised of different levels of fertilizer in five splits at 75%, 100% and 125% of recommended dose of N and K fertilizers given through fertigation, however P was applied as basal and these treatments were compared with drip irrigation with 100% soil application of fertilizers (N in 3 splits). Whereas, sub plot treatments comprised of five weed management practices viz.,Pendimethalin 1.0 kgha^{-1} PE *fb.* Bispyribac sodium 0.025 kgha^{-1} at 25 DAS; Pretilachlor + Pyrazosulfuron Ethyl 0.615 kgha^{-1} PE *fb.* Bispyribac sodium 0.025 kgha^{-1} at 25 DAS; Pretilachlor 0.75 kgha^{-1} PE *fb.* Bispyribac sodium 0.025 kgha^{-1} at 25 DAS; farmer practices - 2 HW at 15–20 days interval after sowing *fb.* 2 hoeing and weedy check.

The soil of experimental field was vertisol, low in available nitrogen (170.41 kgha^{-1}), medium in phosphorus (18.94 kgha^{-1}) and organic carbon (0.42 %), rich in available potassium (360.41 kgha^{-1}) and slightly alkaline in reaction (7.65). Rice variety *Avishkar* was sown on 19th June, 2020 at a spacing of 20 cm×10 cm. The experimental site was established with inline drip irrigation system (16 mm) and 9 laterals were laid treatment^{-1} with emitter spacing of 50 cm and dripper discharge of 4 lph/hr. Irrigation water was applied through drip irrigation system on every alternate day based on cumulative pan evaporation and surface irrigation water was applied at 1.0 IW/CPE ratio at a depth of 6 cm. The drip irrigation water to be applied per plant was determined by the formula given by Michael (2008) [6]. The sources of nutrients were urea (46% N), single super phosphate (16% P2O5), and murate of potash (60% K2O) for nitrogen, phosphorus and potash, respectively. The fertilizer was applied as per the treatments. The application of herbicide was done as per the treatments with manually operated knapsack sprayer attached with a flat fan nozzle. After calibrating the sprayer, water volume used was 700 l/ha. for PE and 500 l ha^{-1}. for PoE. Water use efficiency of rice crop was worked out for all treatments as the ratio of yield of marketable yield to the seasonal water requirement of rice. The plants removed for dry matter study at harvest were used for estimation of nitrogen, phosphorus and potassium content. These plants were dried, and nitrogen, phosphorus and potassium content in plant and grain were estimated by Kjeldahl method, di-acid extract by vanado-molybdate yellow colour method (Piper, 1966) [7] and Flame photometer method respectively. Nutrient use efficiency was calculated by using following formula and expressed in per centage (Crasswell and Godwin, 1984).[8] Data on various parameters were analyzed by using statistical method of analysis of variance as per the standard procedure.

3. RESULTS AND DISCUSSION

3.1 Nutrient uptake

The data presented in Table 1 indicated that, uptake of nutrients by rice was differed significantly due to different fertilizer levels given through fertigation. The maximum uptake of nitrogen (133.93 kgha^{-1}), phosphorus (26.99 kgha^{-1}) and potassium (137.34 kgha^{-1}) by rice was recorded in drip fertigation with 125% RDNK in 5 Splits which was at par with drip fertigation of 100% RDNK in 5 Splits. The lowest uptake of 96.75 N kgha^{-1}, 19.25 P kgha^{-1} and 107.29 K kgha^{-1} was observed in drip irrigation with 100% RDF through soil application (N in 3 Splits). 125% RDNK showed 38.43, 40.21 and 28.01% more N, P and K uptake respectively than 100% RDF through conventional method of soil application. The concentration and availability of various nutrients in the soil for plant uptake depends on soil solution phase which is mainly determined by soil moisture availability. The higher available soil moisture was provided due to continuous water supply at alternate days under drip irrigation which led to higher availability of nutrients in the soil and thereby increased the nutrient uptake under drip fertigation levels in splits. An application of N and K given through fertigation not only stimulated vegetative growth and foraging capacity of roots, but also encouraged the absorption and translocation of more nutrients under higher drip fertigation levels. Reducing the fertilizer dose resulted in reduced availability of nutrients which might be the reason for lower uptake of nutrients by crop at lower doses of fertilizers as indicated in the present study (Table 1). In conventional method of soil application of fertilizers, application of large quantity of fertilizers as a single dose resulted in higher volatilization losses of nutrients and resulted lower the availability of nutrients during later growth stages of crop. This might be the reason for lower uptake of nutrients by crop, when fertilizers are applied by conventional soil application. Better availability of moisture and nutrients throughout the growth stages in drip system leading to better uptake of nutrients. Similar results were reported by Hebbar *et al*. (2004) [9].

The uptake of nutrients by rice was differed significantly due to different weed management practices. The maximum uptake of nitrogen (123.25 $kgha^{-1}$), phosphorus (24.68 $kgha^{-1}$) and potassium (129.94 $kgha^{-1}$) by rice was found in farmers practice of 2 HW at 15-20 days interval after sowing *fb.*2 hoeing which was found at par with Pretilachlor + Pyrazosulfuron ethyl @ 0.615 a.i. $kgha^{-1}$ PE *fb.* Bispyribac sodium @ 0.025 a.i. $kgha^{-1}$ at 25 DAS with N-P-K 120.31 N $kgha^{-1}$, 24.40 P $kgha^{-1}$ and 125.91 K $kgha^{-1}$). Among herbicidal treatments application of Pretilachlor + Pyrazosulfuron ethyl @ 0.615 a.i. $kgha^{-1}$ PE *fb.* Bispyribac sodium @ 0.025 a.i. $kgha^{-1}$ at 25 DAS showed 30.70, 31.04 and 23.32% more N, P and K uptake respectively than weedy check. This might be due to reduced crop-weed competition favourably influenced growth, as there was favourable soil environmental condition which resulted in increasing soil nutrient mineralization and thereby increased in residual status of soil nutrient after harvest of rice crop. Similar findings are given by Sunil *et al*. (2010) [10] Patel *et al*. (2018) [11], Saravanane *et al*. (2020) [12].

3.2 Water use efficiency

In the present investigation, there was a positive relation among increasing drip fertigation level and rice grain yield. The highest WUE of 4.14 $kgha^{-1}$ mm was registered under drip fertigation with 125% RDNK in 5 Splits followed by 3.86 $kgha^{-1}$ mm in drip fertigation with 100% RDNK in 5 Splits. However, the lowest water use efficiency of 3.69 $kgha^{-1}$ mm in drip irrigation with 100% RDF through soil application. Recommended dose of N and K registered 12.19 % more WUE than 100% RDF through soil application. In case of drip fertigation with 125% RDNK in 5 splits, the amount of carbon assimilated as biomass or grain produced per unit of water used by the rice crop was more resulted in increased the WUE. As in drip fertigation with 125% RDNK in 5 Splits the rice grain yield was the highest one, for that the WUE was maximum in that treatment which was significant than the drip irrigation with 100% RDF soil application (N in

3 Splits) where fertilizer was applied through soil application. This result was in accordance with results earlier reported by Deshmukh and Katake (2005) [13], Jagadish *et al*. (2019)[14] and Ashrafi *et al*.(2020)[15]

The water use efficiency was higher in all other weed management practices than weedy check. The highest water use efficiency (4.37 $kgha^{-1}$ mm) was recorded in farmer practices of 2 hand weeding at 15-20 days interval after sowing *fb*. 2 hoeing followed by Pretilachlor + Pyrazosulfuron ethyl @ 0.615 a.i. $kgha^{-1}$ PE fb. Bispyribac sodium @0.025 a.i. $kgha^{-1}$ at 25 DAS with WUE of 4.24 $kgha^{-1}$ mm and the lowest WUE was recorded in weedy check (2.74 $kgha^{-1}$ mm). Among all herbicidal treatments application of Pretilachlor + Pyrazosulfuron ethyl @ 0.615 a.i. $kgha^{-1}$ PE *fb*. Bispyribac sodium @ 0.025 a.i. $kgha^{-1}$ at 25 DAS showed 54.74% more WUE than weedy check. Different weed management practices gave higher water use efficiency than weedy check, which might be due to less infestation of weeds in these treatments, which provide sufficient quantity of water for growth and development of rice crop. The similar results regards to WUE was reported by Kumaran *et al.* (2015) [16], Mishra *et al*. (2018) [17], Singh *et al.* (2018) [18], Ramesh and Rathika (2020) [19] .

3.3 Nutrient use efficiency

The data presented in Table 1 showed that, the highest NUE of 23.67 was registered under drip fertigation with 75% RDNK in 5 Splits followed by drip fertigation with 100% RDNK in 5 Splits (19.83), Drip irrigation with 100% RDF soil application (18.63) and the lowest in drip fertigation with 125% RDNK in 5 Splits (17.91). Nutrient use efficiency at 75% RDNK was 37.68% more than 100% RDF through soil application. In case of drip fertigation there was efficient utilization and precise application of nutrients according to the nutritional requirements of the crop as compared to conventional soil application of fertilizers. Similar kind of result were reported by Modinat *et al*. (2014) [20].

The nutrient use efficiency was higher in all other weed management practices than weedy check. The highest NUE was recorded in farmer practices i.e. 2 HW at 15-20 days interval after sowing *fb*. 2 hoeing (22.45 $kgkg^{-1}$) and the lowest NUE was recorded in weedy check treatment (12.41 $kgkg^{-1}$). Among all herbicidal treatments application of Pretilachlor + Pyrazosulfuron ethyl @ 0.615 a.i. $kgha^{-1}$ PE fb. Bispyribac sodium @ 0.025 a.i. $kgha^{-1}$ at 25 DAS showed 75.66% more NUE than weedy check. In case of Pretilachlor + Pyrazosulfuron ethyl @ 0.615 a.i. $kgha^{-1}$ PE *fb*. Bispyribac sodium @ 0.025 a.i. $kgha^{-1}$ at 25 DAS), higher rice grain yield was obtained rather than other herbicidal applied treatments so NUE was maximum in this treatment after farmer practices i.e. 2 HW at 15-20 days interval after sowing *fb.* 2 hoeing. Results shown by Singh *et al*. (2014) [21] also supported maximum rice grain yield could be the reason for higher NUE.

3.4 Availability of major nutrients at harvest

The data of available N, P and K of soil at harvest is presented in Table 1 which indicated that, there was significant difference in the values of available N, P and K of soil as influenced by different fertigation levels and weed management practices after harvest. In case of available N, P and K at harvest, it was observed that maximum value of available N, P and K of soil was observed in treatment of drip fertigation with 125% RDNK in 5 splits i.e.185.38, 21.15 and 374.15 kgha^{-1} respectively and the and the lowest amount of available N, P and K of soil was observed in Drip irrigation with 100% RDF through soil application i.e.175.79, 19.13 and 362.68 kgha^{-1} respectively. Significantly more nitrogen, phosphorus and potassium were remained in soil where higher level of fertilizer dose of 125 per cent RDNK per ha applied through fertigation. While minimum soil available nutrients were observed in soil application of 100 per cent RDF per ha due to leaching and evaporation losses of fertilizer. In case of drip fertigation, significantly higher nutrient content in upper soil layers compared to conventional soil application of fertilizers. While, among the weed management practices, farmer practices i.e. 2 HW at 15-20 days interval after sowing *fb*. 2 hoeing recorded maximum availability of N,P and K at harvest (195.22, 20.85 and 373.01 kgha^{-1} respectively) followed by Pretilachlor + Pyrazosulfuron ethyl @ 0.615 a.i. kgha^{-1} PE *fb*. Bispyribac sodium @ 0.025 a.i. kgha^{-1} at 25 DAS and lowest availability of nutrients in weedy check. The great improvement in available nutrient status of soil after harvest can be described as the cumulative effect of added nutrient to the soil and indirect addition through leaf drop and root debris backed up by favorable soil microbial activity because of good soil moisture availability through drip irrigation throughout the crop growth which might have converted immobilized organically bound nutrients into inorganic available form. As the weed population was less in herbicidal treatment of Pretilachlor + Pyrazosulfuron ethyl @ 0.615 a.i. kgha^{-1} PE *fb*. Bispyribac sodium @ 0.025 a.i. kgha^{-1} at 25 DAS so the available nutrients status was more in that after harvest. These results are in conformity with the results reported earlier by Sunil *et al*. (2010) [10], Patel *et al*. (2018) [11] and Saravanane (2020)[12].

3.5 Rice grain and straw yield

Each higher fertigation level of recommended dose of N and K significantly increased the grain, straw and biological yield kgha^{-1}) over its lower levels and soil application with drip as indicated in Table 2. The grain yield and straw yield were influenced significantly due to split application of recommended dose of nitrogen and potash through fertigation. Grain yield (5103 kgha^{-1}), straw yield (7268 kgha^{-1}) and harvest index (41.25%) were observed at 125% RDNK. The fertigation method offered an opportunity for precise application of water-soluble fertilizers and other nutrients to the soils at appropriate time with the desired concentration. Fertigation combined water and fertilizer which minimized the nutrient loss that helped in better grain yield, straw yield, biological yield and harvest index in rice.

Among herbicidal treatments the application of Pretilachlor + Pyrazosulfuron ethyl @ 0.615 a.i. kgha^{-1} PE *fb*. Bispyribac sodium @ 0.025 a.i. kgha^{-1} at 25 DAS helped in preventing weed shift towards perennial nature and shifted the crop-weed competition in favour of crop. These all favored in maximum grain yield (5231 kgha^{-1}), straw yield (7603 kgha^{-1}) and harvest index of 41.25%. Whereas, in case of weedy check due to high weed population and high nutrient uptake by the weeds there was decrease in yield of rice crop. Pretilachlor was readily taken up by the hypocotyls, mesocotyls and coleoptiles and to a lesser extent by roots of germinating weeds; Pyrazosulfuron ethyl inhibited acetolactate synthase in weeds and Bispyribac sodium inhibited the amino acid formation in weeds. These results were in conformity with the findings of Parthasarathi *et al*. (2018) [22], Patil *et al*. (2019) [23]

3.6 Economics of fertigation and weed management practices

Among all the fertigation levels the highest gross monetary return (₹120353 ha^{-1}), net monetary return (₹72924 ha^{-1}) and B:C ratio (2.54) were obtained in the treatment receiving drip fertigation at 125% RDNK kg ha^{-1}. (Table 2). Lowest GMR, NMR and B:C ratio were registered in the drip irrigation with conventional soil application of 100% RDF (N in 3 splits). Adoption of drip fertigation is very much important as it gives higher B:C ratio by minimizing the cost of cultivation. In case of weedy check, GMR was lowest due to heavy weed infestation and very less rice yield. This might be reason behind the lowest B:C ratio in weedy check. Drip fertigation with 125% RDNK was economically viable than other treatments as there more GMR was obtained. Similar types of result were found by the results reported by Nayak *et al*. (2016)[24] and Parthasarathi *etal.* (2018) [21]. Among the herbicides, application of Pretilachlor+Pyrazosulfuron Ethyl @ 0.615 a.i. kg ha^{-1} PE fb. Bispyribac sodium @ 0.025 a.i. kg ha^{-1} at 25 DAS showed the highest gross monetary return (₹128755/ha), net monetary return (₹81412/ha) and B:C ratio (2.72). Weeds are main enemy of crops as they retarded the growth, development of a crop by competing with the crop for nutrients, water, solar radiation etc. Similar types of result were found by the results reported Upasani *et al.* (2012) [25].

4.CONCLUSIONS

On the basis of the data, it could be concluded that application of drip fertigation with 125% RDNK in five splits and directed application of Pretilachlor + Pyrazosulfuron ethyl @ 0.615 a.i. kg ha^{-1} PE *fb*. Bispyribac sodium @ 0.025 a.i. kg ha^{-1} at 25 DAS found to be the best for enhancing the nutrient uptake, nutrient use efficiency, water use efficiency, availability of major nutrients at harvest and maximizing the yield and beneficial for increasing the productivity and economic returns of rice under different fertigation levels and weed management practices.

Table 1: Nutrient uptake, water use efficiency, nutrient use efficiency and availability of nutrients as influenced by different fertigation levels and weed management practices in rice

Treatments	Nutrient uptake (kgha^{-1})			WUE (kgha-1 mm)	NUE (kgkg^{-1})	Available nutrient (kgha^{-1})		
	N	P	K			N	P	K
A) Fertigation Levels								
F_1: Drip irrigation with 100% RDF soil application (N in 3 Splits)	96.75	19.25	107.29	3.69	18.63	175.79	19.13	362.68
F_2: Drip fertigation with 75% RDNK in 5 Splits	104.38	21.29	111.59	3.75	23.67	178.24	19.55	366.02
F_3: Drip fertigation with 100% RDNK in 5 Splits	119.22	24.72	127.49	3.86	19.83	181.52	20.60	369.33
F_4: Drip fertigation with 125% RDNK in 5 Splits	133.93	26.99	137.34	4.14	17.91	185.38	21.15	374.15
SE (m)±	5.17	0.99	4.75	--	--	2.67	0.45	3.49
CD (P=0.05)	17.91	3.42	16.44	--	--	8.38	1.54	10.64
B) Weed Management Practices								
W_1:Pendimethalin 1.0 kgha^{-1} PE *fb.*Bispyribac sodium 0.025 kgha^{-1} at 25 DAS	114.72	23.66	122.28	4.06	20.85	180.31	19.23	364.49
W_2:Pretilachlor+Pyrazosulfuron Ethyl 0.615 kgha^{-1} PE *fb.* Bispyribac sodium 0.025 kgha^{-1} at 25 DAS	120.31	24.40	125.91	4.24	21.80	189.84	19.92	369.83
$W_{3:}$Pretilachlor 0.75 kg a.i. ha^{-1} PE *fb.* Bispyribac sodium @ 0.025 a.i. kgha^{-1} at 25 DAS	117.52	23.95	124.39	4.13	21.20	183.12	19.43	366.38
W_4:Farmer practices- 2 HW at 15–20 days interval after sowing *fb.* 2 hoeing	123.25	24.68	129.94	4.37	22.45	195.22	20.85	373.01
W_5: Weedy check	92.05	18.62	102.10	2.74	12.41	169.57	18.15	356.78
SE (m)±	5.40	1.27	5.00	--	--	3.51	0.31	3.80
CD at 5%	15.56	3.65	14.40	--	--	10.11	0.90	9.15
Interaction (F×W)								
SE (m)±	10.80	2.53	10.00	--	--	7.01	0.63	1.36
CD (P=0.05)	NS	NS	NS	--	--	NS	NS	NS

Table 2: Grain yield, straw yield (kgha-1)), harvest index (%) and economics of rice as influenced by different fertigation levels and weed management practices

Treatments	Grain yield (kgha^{-1})	Straw yield (kgha^{-1})	Harvest Index (%)	GMR (₹ha^{-1})	NMR (₹ha^{-1})	B:C ratio
A) Fertigation Levels						
F_1: Drip irrigation with 100% RDF soil application (N in 3 Splits)	4471	6593	40.41	108407	62589	2.37
F_2: Drip fertigation with 75% RDNK in 5 Splits	4617	6724	40.71	111168	66639	2.50
F_3: Drip fertigation with 100% RDNK in 5 Splits	4760	6867	40.94	113871	68053	2.49
F_4: Drip fertigation with 125% RDNK in 5 Splits	5103	7268	41.25	120353	72924	2.54
SE (m)±	28.37	45.57	--	536	536	--
CD (P=0.05)	101.00	160.30	--	1853	1853	--
B) Weed Management Practices						
W_1: Pendimethalin 1.0 kgha^{-1} PE *fb.*Bispyribac sodium 0.025 kgha^{-1} at 25 DAS	5004	7294	40.69	124479	75973	2.57
W_2: Pretilachlor+Pyrazosulfuron Ethyl 0.615 kgha^{-1}PE *fb.* Bispyribac sodium 0.025 kgha^{-1} at 25 DAS	5231	7603	40.76	128755	81412	2.72
W_3: Pretilachlor 0.75 kgha^{-1} PE *fb.* Bispyribac sodium 0.025 kg /ha at 25 DAS	5087	7402	40.73	126035	78062	2.63
W_4: Farmer practices- 2 HW at 15–20 days interval after sowing *fb.* 2 hoeing	5389	7656	41.31	131749	80229	2.56
W_5: Weedy check	2978	4350	40.64	56233	13287	1.31
SE (m)±	46.29	72.51	--	874	874	--
CD at 5%	134.00	212.20	--	2519	2519	--
Interaction (F×W)						
SE (m)±	75.43	118.08	--	1748	1748	--
CD (P=0.05)	NS	NS	--	NS	NS	--

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