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Effect of weed control on the performance of transplant BRRI *Dhan* 32

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Abstract

A field experiment was carried out at the Agronomy Field Laboratory, Bangladesh Agricultural University, Mymensingh during July to December 2003 to find out the effect of weed control on the performance of transplant *Aman* rice cv. BRRI *Dhan* 32. Weed control treatments Included in the study were no weeding, one hand weeding, two hand weeding, one hand weeding+one weeding with Japanese rice weeder, Rift@ 0.5, 0.75, 1.0, and 1.25 L ha-1 and Rostar@ 1.0, 1.5, 2.0, and 2.5 L ha-1. Important weed species found to infest the crop were Angta (*Panicum repens),* Acidgras *(Ammania bacifera* L.) Nackphulee *(Cyperous difformis),* Khudeshama *(Echinochloa crusgalli)* was the least important weed species. Higher doses of Rift 1.25L ha-1 and Ronstar 2.5 L ha-1 showed the best performance in reducing weed density and weed dry weight. The highest grain yield (5.0 4ton ha-1) was obtained from Ronstar 2.0 L ha-1 which was identical with the second highest grain yield (4.93 t ha-1) obtained from Rift 1.0 L ha-1. The highest net income of tk. 38915 ha-1 was obtained from Ronstar 2.0 L ha-1 and the next highest from Rift 1.0L ha-1.

Key words: Weed control, *T. Aman*, BRRI *Dhan* 32

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Introduction

Rice ranks the top position among the cereal crops of Bangladesh. It is the staple food for more than two billion in Asia and four hundreds of millions in Africa and Latin America (IRRI, 1985). Among the groups of rice, transplant *Aman* covers about 53.28% of total rice area and contributes to 44.68% of the total rice production in the country (BBS, 2002). Bangladesh ranks fourth in area and production of rice (FAO, 1994) and 39th in yield of rice in the world (IRRI, 1995). The average yield of rice in Bangladesh around 2.15 t ha-1 (BBS, 2002) which is very much lower than that of the highest ranking country (12.9 t ha-1 like China (IRRI, 2001).

Normally hand weeding is done to keep the crop free from weed but this method is uneconomic and becoming more difficult day by day due to the crisis of labours. Labour availability in agricultural sector has decline in recent years due to landless people towards the urban areas with a dream to earn more. Weed is one of the destructive pests in crops. The edaphic climatic conditions of Bangladesh specially in Aman rice favours the growth of weed. High competitive ability of weeds exerts a serious negative effect on the crop production causing significant losses in crop yield (Mamun et al., 1993). Poor weed control is one of the major factors for yield reduction in rice and the extant of whice depends on type of weed flora and their intensity of infestation (Amarjit et al., 1994). Yield loss due to weed infestation is greater than the combined loses of insect pests and diseases in rice

(Islay, 1960). Weeds reduced grain and straw yield about 58.96% and 53.20% in T. *Aman* rice, 71.47% and 47.00% in direct seeded rice respectively (Sarkar, 1996). Crop loss in Bangladesh has been estimated to be tk. 200 million per year due to unrestricted growth of weeds in the fields (Karim, 1987). Weed growth reduced grain yield by 45% for T. *Aman* rice (Mamun, 1990). Weeds are being controlled in Bangladesh by hand pulling or by using simples' tools like niranees, Japanese rice weeder. Usually, two or three hand weeding is being done on T. *Aman* rice depending upon the nature of weed s and intensity of their infestation. But this method is very laborious and time consuming. The use of herbicides may be an alternative method in controlling weeds more easily and at low cost. Herbicides, the chemical weed killers, are the modern means of weed control in present day agriculture in the advance countries of the world (Pillai and Rao, 1974; De Datta, 1980).

Keeping this in view, the present study was undertaken to study the effectiveness and economics of different cultural and chemical methods of weed control in T. *Aman* rice cv. BRRI *Dhan* 32 to assess the different weed control methods and their yield performance.

Materials and Methods

***Experimental field and site*:** A field experiment was carried out at the Agronomy Field Laboratory, Bangladesh Agricultural University, Mymensingh during July to December 2013. The experiment was conducted on a medium high, well drained and leveled land belonging to non calcareous dark grey flood plain soil under Old Brahmaputra Floodplain (AEZ-9).

***Soil*:** The soil was silty loam having 0.11% total nitrogen, 0.93 % organic matter, 16.3 ppm available P, 0.27 % K and 13.9 ppm S with pH value 6.8 collected from 0-15 cm depth of the before opening the field.

***Test Crop*:** The crop under the study was BRRI *Dhan* 32. The cultivar was developed by the Bangladesh Rice Research Institute and it is moderately resistant to leaf blight, blast and tungro diseases (BRRI, 1995).

***Climate*:** Details of the climatic data during the study period have been recorded.

***Description of herbicides*:**

Trade name	Common name	Mode of action	Selectivity	Time of application
Rift	Pretilachlor	Systemic	Selective for rice	Pre-emergence
Ronstar	Oxadiazon	Systemic	For rice and wheat	Pre-emergence

***Treatments*:** The experiment consists of the following weed control treatments:

1. No weeding (W_0): Weeds are allowed to grow in the plot
2. One hand weeding (W_1): Hands weeding was done on 21 day after transplanting
3. Two hand weeding (W_2): Hands weeding was done on 21 and 42 DAT
4. One hand weeding + weeding with Japanese rice weeder (W_3): Hands weeding was done on 21 day after transplanting with Japanese rice weeder
5. Rift 0.5 L ha-1(W_4): was applied on 4 DAT mixing with 250 L water by Knapsack sprayer in presence with 4-5 cm standing water.
6. Rift 0.75 L ha-1(W_5): was applied on 4 DAT mixing with 250 lL water by Knapsack sprayer in presence with 4-5 cm standing water.
7. Rift 1.0 L ha-1: was applied on 4 DAT mixing with 250 L water by Knapsack sprayer in presence with 4-5 cm standing water.
8. Rift 1.25 L ha-1: was applied on 4 DAT mixing with 250 L water by Knapsack sprayer in presence with 4-5 cm standing water.
9. Ronstar 1.0 L ha-1: was applied on 4 DAT mixing with 500 L water by Knapsack sprayer in presence with 4-5 cm standing water.

10. Ronstar 1.5L ha-1: was applied on 4 DAT mixing with 500 litres water by Knapsack sprayer in presence with 4-5 cm standing water.
11. Ronstar 2.0 L ha-1: was applied on 4 DAT mixing with 500 litres water by Knapsack sprayer in presence with 4-5 cm standing water.
12. Ronstar 2.5 L ha-1: was applied on 4 DAT mixing with 500 L water by Knapsack sprayer in presence with 4-5 cm standing water.

***Experimental Procedure*:** The experiment was laid out in a RCBD design with four replications. Unit plot size was 10sq. m. The sprouted seeds were broadcast in the nursery bed on 7 July 2013. The field was fertilized with urea, TSP, MP, gypsum and zinc sulphate @ 150, 100, 70, 60, 10kg ha-1 respectively. 30 days old seedlings were transplanted in the unit plots on 7 august, 2103. The crop was harvested plot wise at full maturity on 17 November, 2013.

Data collection: The data were collected on the following parameter:

i. Plant height, ii. Total no. of tillers per hill, iii. No. of ear bearing tillers per hill, iv. No. of non ear bearing tillers per hill, v. Panicle length, vi. No. of grains per panicle, vii. No. of sterile spikelets per panicle, viii.1000-grain weight, ix. Grain yield, x. Straw yield, xi. Biological Yield, xii. Harvest index.

***Statistical analysis*:** Data were analyzed statistically using analyzed with computer package program MSTAT and the mean differences were adjudged by Duncan's Multiple Range Test (DMRT) (Gomez and Gomez, 1984) and ranking was indicated by letters.

Results and Discussion

***Infesting weed species of the experimental field*:** Ten weed species belonging to five families infested the experimental crop. Their local name, scientific name, family, morphological type, life cycle, density and dry weight have been presented in Table 1. Among the weed species of 3 sedges, 3 broad leaved and 4 grasses. Density and dry weight of weeds varied considerably in different weed control treatments. The most important weeds of the experimental plots was *Panicum repens* (25.63/m^2) and the second important one was *Ammania bacifera* L.(7.66/m^2) and the least important was *Echinochloa crusgalli* (1.67/m^2). From the result it was clear that *Panicum repens* was not effectively controlled by the weed control treatments. It might be due to difficulty in destroying their hardy and slow rotting propagules and its higher propagation ability through stem. Similar result was also reported by BRRI (1997).

Table 1. Infesting weed species of the experimental plot in transplant *Aman* rice cv. BRRI *Dhan* 32.

SL	Local name	Scientific name	Family	Morphological type	Life cycle	Density (no. m^{-2})	Dryweight (no.m^{-2})
1	Angta	*Panicum repens*	Gramineae	Grass	Perennial	25.63	12.45
2	Acid ghash	*Ammania bacifera*	Lythraceae	Broadleaved	Annual	7.66	3.01
3	Nackphulee	*Cyperus difformis*	Cyperaceae	Sedge	Annual	6.18	1.87
4	Khudey shama	*Echinochloa colonum*	Gramineae	Grass	Annual	5.52	3.38
5	Panikachu	*Manochoria vaginalis*	Pontederiaceae	Broadleaved	Perennial	5.27	2.05
6	Jaina	*Fimbristylis miliaceae*	Cyperaceae	Sedge	Annual	4.90	2.18
7	Arail	*Leersia hexandra*	Gramineae	Grass	Perennial	4.50	2.85
8	Amrulshak	*Oxalis europaea*	Oxaliadaceae	Broadleaved	Annual	2.67	1.09
9	Chehcra	*Scirpus mucronatus*	Cyperaceae	Sedge	Perennial	2.67	1.00
10	Shama	*Echinochloa crusgalli*	Gramineae	Grass	Annual	1.67	2.90

***Effect of weed control treatments on weed density*:** Weed vegetation was recorded at flowering stage of the rice plant. A great variation in weed density of weeds was observed under different weed control treatments (Table 2). The highest weed density (104.97m^2) was observed in the no weeding treatment followed by one hand weeding. The lowest weed density 9.95m^2 observed in Ronstar 2.5 L ha-1 was followed by Rifit 1.25 Lha^{-1} and Ronstar 2.0 Lha^{-1} having weed densities 11.14, 18.37 m^2, respectively which was statistically identical with each other.

***Effect of different treatments on dry weight of weeds*:** The weed dry weight was significantly influenced by different weed control treatments. The highest weed dry weight (68.63gm^{-2}) was recorded from the no weeding treatment (Table 2) was followed by one hand weeding (53.87gm^{-2}). The least weed dry weight (3.67gm^{-2}) was recorded in Rifit 1.25 L ha-1which was statistically identical to treatment W6, W10 and W11. The highest weed control efficiency (92.08%) was recorded from Ronstar 2.5 L ha^{-1} which was followed by treatment W_6, W_7, and W_{10}, respectively. Among the weed control treatment the lowest weed control efficiency (21.50%) was recorded from one hand weeding treatment.

***Phytotoxicity of herbicide in rice plants*:** The degree of toxicity of Rifit and Ronstar to rice plant and the toxic symptoms produced have been presented in Table 3. It can be seen that lower doses of Rifit and Ronstar showed no toxicity on plant but Rifit 1.25 L ha^{-1} showed a temporary slight yellowing of leaves which required 5-7 days to recover . Similar result was observed by Islam (2001). Among the pre emergence herbicide slight phytitoxicity was found in Ronstar at recommended (2.0L ha^{-1}) and higher doses of Rifit (1.25Lha^{-1}) showed slight temporary yellowing of leaves (Table 3). It is obvious that Ronstar 2.0 Lha^{-1} and 2.5 Lha^{-1} produced remarkable toxic effects like leaf tips turned brown and dried, plant growth stunted, stem become narrow with few number of injured leaves on rice plants which was required 7-10 days to recover. Almost similar findings were also observed by IRRI (1975) and Khemphel and Rangsit (1986).

Table 2. Effect of treatments on density and dry weights of weeds.

Treatment	Weed density (no. m^{-2})	Weed Dry weight (g m^{-2})
No weeding (W0):	104.97** (0.00)*	68.63a (0.00)
One hand weeding (W_1)	85.84b (18.22)	53.87b (21.50)
Two hand weeding (W_2):	39.15d (62.70)	19.75d (71.22)
One hand weeding + weeding with Japanese rice weeder (W_3)	51.82c (50.63)	26.35c (61.60)
Rift 0.5 L ha-1 (W_4)	37.17d (64.58)	15.64e (77.21)
Rift 0.75 L ha-1(W_5)	40.17d (61.73)	13.64e (80.12)
Rift 1.0 L ha-1(W_6)	20.54e (80.43)	6.51f (90.51
Rift 1.25 L ha-1(W_7)	11.14f (89.38)	3.67f 94.65
Ronstar 1.0 L ha-1(W8)	49.63c (52.71)	28.52c 958.44)
Ronstar 1.5 L ha-1(W_9)	37.39d (64.38)	15.46e (77.47)
Ronstar 2.0 L ha-1(W_{10})	18.37ef (82.49)	5.61f (91.82)
Ronstar 2.50 L ha-1(W_{11})	9.95f (90.52	5.43f (92.08)
Level of significance	0.01	0.01
CV (%)	10.92	8.50

** In column, means having common letter(s) do not differ significantly, * The figure in parenthesis indicated the weed control efficiency.

***Plant height*:** The tallest plant height (136.75) was obtained from the application of Ronstar 1.0 L ha^{-1} which was statistically identical with the rest of treatments except W_0 and W_1 (Table 4). The lowest plant height produced (119.50 cm) produced in no weeding treatment. Result indicated that heavy weed infestation in the no weeding treatment might have

hampered the normal growth and development of rice plants become shorter.

Table 3. Rating of phytotoxicity of herbicides and the symptoms observed in transplant aman rice cv. BRRI dhan 32.

Treatments	Rating	Symptoms observed on the crop
Rift 0.5 L ha-1(W_4)	1.0	No toxicity symptom observed
Rift 0.75 L ha-1(W_5)	1.0	No toxicity symptom observed
Rift 1.0 L ha-1(W_6)	1.1	No toxicity symptom observed
Rift 1.25 L ha-1(W_7)	1.2	Temporary slight yellowing of leaves was found which required 5-7 days to recover
Ronstar 1.0 L ha-1(W8)	1.0	No toxicity symptom observed
Ronstar 1.5 L ha-1(W_9)	1.1	No toxicity symptom observed
Ronstar 2.0 L ha-1(W_{10})	1.2	Slight toxic, slight yellowing, browning of leaves, burning of leaf and plant growth stunted which required 7-10 days to recover
Ronstar 2.50 L ha-1(W_{11})	1.3	Slight toxic, slight yellowing, browning of leaves, burning of leaf and plant growth stunted which required 7-10 days to recover

***Number of total tillers per hill*:** The highest total no of tillers per hill (16.10) was produced by the treatment Ronstar 2.0 L ha^{-1} and the second highest total no of tillers per hill (14.20) was produced by the treatment Ronstar 1.0 L ha^{-1}, which was identical with the treatment W_1, W_2, W_3, W_4, W_7 and W_{11}. This might be due to the fact that the severe weed infestation failed to produce more tillers in those experimental plots. Similar results were also reported by IRRI (1998), Attalla and Kholosy (2002).

***Number of ear bearing tillers per hill*:** From the data, it may be observed that the treatment Ronstar 2.0 Lha^{-1} produced the highest ear bearing tillers per hill (12.95) which was statistically similar to the treatment two hand weeding. Lowest ear bearing tillers per hill (97.10) recorded in no weeding. Similar findings were also reported by Sanjoy *et al.* (1999).

***Number of non -ear bearing tillers per hill*:** Number of non ear bearing tillers per hill was not significantly influenced by different weed control treatments.

***Panicle length*:** The highest panicle length (24.33) obtained from the treatment Rifit 0.75 L ha^{-1} was statistically similar to the treatment two hand weeding, one hand weeding + weeding with Japanese rice weeder, Rifit 0.50 Lha^{-1}, Rifit 1.0 Lha^{-1}, Rifit 2.0 Lha^{-1}, Rifit 2.5 Lha^{-1}. Due to higher combination weeds with the crop plants ultimately panicle length might have reduced.

***Number of grains per panicle*:** Total no. of grains per panicle was the highest (119.49) in the treatment Ronstar 2.0 Lha^{-1}. The second highest (113.49) total number of grains per panicle was in the treatment two hand weeding. The lowest number recorded (81.32) in the no weeding treatment. Similar findings were also reported by Sanjoy *et al.* (1999).

***Sterile spikelets per panicle*:** The highest number of sterile spikelets (27.02) was observed in no weeding treatment which was significantly higher than those of other treatments. On the contrary, the lowest (16.89) and the second lowest (18.40) number of sterile spikelets per panicle was observed in the treatment Ronstar 2.0 Lha^{-1} and Rifit 1.0 Lha^{-1} respectively. Weed severity and environmental condition perhaps the, the main reason for such variation of the number of sterile spikelets per panicle in the different weed control treatments.

***1000-grain weight*:** Thousands grain weight was not significantly influenced by different weed control treatments although they numerically differed among themselves. Similar findings were also found by Islam (2001) and Polthanee *et al*. (1996).

***Grain yield*:** Among the weed control treatments, the highest grain yield (5.04 tha^{-1}) was observed in the

Ronstar 2.0 Lha^{-1}. The second highest grain yield (4.93 tha^{-1}) was recorded in the Rifit 1.0 Lha^{-1}which was identical of the two hand weeding, one hand weeding + one weeding Japanese rice weeder, Rifit 1.25 Lha^{-1} Rifit 0.75 Lha^{-1} and Ronstar 1.0 Lha^{-1}. This was the outcome of severe competition for moisture, spaces, light and nutrients between weeds and eventually grain yield s were reduced.

Table 5. Effect of weed control treatments on the crop characters of transplant *Aman* rice cv. BRRI *Dhan* 32.

Treatments	Plant height	Number of total tillers per hill	Ear bearing tillers per hill	Non -ear bearing tillers per hill	Panicle length	Grains per panicle
No weeding(W_0):	119.50c*	9.90 d	7.10 c	2.80	20.80e	81.32e
One hand weeding(W_1)	122.00bc	12.60 bc	8.45 bc	4.15	23.29d	86.06de
Two hand weeding(W_2):	130.50abc	13.60 bc	10.60 ab	4.00	23.68a-d	113.49ab
One hand weeding + weeding with Japanese rice weeder(W_3)	130.75ab	12.65 bc	9.25 bc	3.40	23.91a-d	85.61de
Rift 0.5 L ha-1(W_4)	127.25 abc	13.10 bc	9.85 b	3.25	24.22ab	94.07cde
Rift 0.75 L ha-1(W_5)	133.00 ab	12.35 c	8.85 bc	3.50	24.33a	103.22bc
Rift 1.0 L ha-1(W_6)	132.75 ab	12.20 c	9.35 bc	2.85	23.75a-d	105.55bc
Rift 1.25 L ha-1(W_7)	131.25 ab	13.50 bc	9.15 bc	4.35	23.58b-d	99.75bcd
Ronstar 1.0 L ha-1(W8)	136.75 a	14.20 b	10.15 b	4.05	23.49cd	100.78bc
Ronstar 1.5 L ha-1(W_9)	134.75 a	12.20 c	8.90 bc	3.30	23.32d	95.38cde
Ronstar 2.0 L ha-1(W10)	132.25 ab	16.10 a	12.95 a	3.15	23.77a-d	11949a
Ronstar 2.50 L ha-1(W_{11})	133.75 ab	12.60 bc	9.80 b	2.80	24.01abc	93.37cde
Level of significance	0.01	0.05	0.01	NS	0.01	0.01
CV(%)	10.08	11.52	12.87	6.23	5.08	8.44

Table 5. Continued

Treatments	Sterile spikelets per panicle(no.)	1000-grain weight(g)	Grain yield (t ha-1)	Straw yield (t ha-1)	Biological yield(t ha-1)	Harvest index(%)
No weeding(W0):	27.02a	20.43	2.42c	3.95e	6.37d	38.01d
One hand weeding(W_1)	25.46ab	19.90	3.55b	5.35a-b	9.04c	40.57cd
Two hand weeding(W_2):	18.79bc	20.7	4.62ab	6.01abc	10.64abc	43.28bc
One hand weeding + weeding with Japanese rice weeder(W_3)	21.59abc	21.07	4.33ab	4.76de	9.09bc	47.85a
Rift 0.5 L ha-1(W_4)	21.58 abc	20.07	4.06ab	5.15bcd	9.21bc	43.92bc
Rift 0.75 L ha-1(W_5)	22.45 abc	20.63	4.41ab	5.55a-d	9.96abc	44.24abc
Rift 1.0 L ha-1(W_6)	18.40 bc	20.30	4.93a	6.16ab	11.09ab	44.45ab
Rift 1.25 L ha-1(W_7)	20.34 abc	19.93	3.86b	5.05b-e	8.90c	43.15bc
Ronstar 1.0 L ha-1(W8)	19.37 abc	20.14	4.06ab	5.24bcd	9.30bc	43.60bc
Ronstar 1.5 L ha-1(W_9)	22.05 abc	19.92	3.87b	4.88cde	8.74c	44.29abc
Ronstar 2.0 L ha-1(W10)	16.89 c	19.53	5.04a	6.45a	11.50a	43.82bc
Ronstar 2.50 L ha-1(W_{11})	22.52 abc	19.81	3.82b	4.70de	8.53c	44.80ab
Level of significance	0.01	NS	0.01	NS	0.01	0.01
CV(%)	9.83	5.35	8.3	10.38	6.28	7.51

*In column, means having common letter(s) do not differs significantly, NS= Not Significant

***Straw yield*:** The highest straw yield (6.45 t ha^{-1}) were obtained from the treatment Ronstar 2.0 L ha^{-1} .the next highest straw yield (6.16 t ha^{-1}) was observed in the Rifit 1.0 L ha^{-1}. The treatments W_1, W_2 W_4 W_5 W_7 and W_8 produced statistically similar straw yield.

***Biological yield*:** The highest Biological yield (11.50 t ha^{-1}) was obtained from the treatment Ronstar 2.0 L ha^{-1}. The second highest Biological yield (11.09 t ha-1) from the treatment Rifit 1.0 L ha^{-1}. The lowest biological yield (6.37 t ha^{-1}) observed in the no weeding treatment. The treatments W_2 W_3 W_4 W_5 and W_8 noted statistically similar biological yield.

***Harvest index*:** The highest Harvest index (47.85%) was obtained from the treatment 1 hand weeding + 1 weeding with JRW which was similar of the treatments W_5, W_6 W_9 and W_{11}. The second highest harvest index (38.01) was obtained from Ronstar 2.5 L ha^{-1}. The lowest harvest index (38.01%) was obtained in the no weeding treatment.

Conclusion

The weed dry weight was significantly affected by weed control treatments. The lowest weed density (9.95) and dry weight (5.43) were observed in Ronstar 2.5 L ha^{-1} and was followed by the treatment Rifit 1.25 L ha^{-1}. The highest weed density (104.97) and dry weight (68.63g m2) were obtained from the no weeding treatment which was significantly higher than those of other treatments. Application of Ronstar 2.5 L ha^{-1} showed slight phototoxic effect on the rice plant which recovered within six days. Higher doses of Rifit and Ronstar showed better performance in reducing the weed density and increasing the weed control efficiency than the lower doses.

All the characters except number of non -ear bearing tillers per hill and 1000- grain weight were significantly influenced by the weed control treatments. No weeding showed the inferiority than other weed contril treatments. Two hand weeding and Ronstar 2.0 l ha-1 and Rifit 1.0 L ha-1 gave statistically identical effects in respect of plant hight ,no. of total tillers per hil , No. of ear bearing tillers per hil ,No. of non ear bearing tillers per hil, Panicle length,total no. of grains per panicle, sterile, spiklets per panicle ,1000 grain weight, grain yield, straw yield, biological yield. Ronatar 2.0 L ha^{-1} was produced highest grain yield (5.04 t ha^{-1}) and straw yield (6.45 t ha^{-1}) due to production of maximum number of grains (119.49 $panicle^{-1}$). The second highest grain and straw yield was obtained from Rifit 1.0 L ha-1.

From the economic analysis of the study the highest net income was obtained from the treatment of Ronstar 2.0 L ha^{-1} (Tk. 38915 ha^{-1}) followed by Rifit 1.0 L ha^{-1} and two weeding treatment. The herbicides Ronstar 2.0 L ha^{-1} and Rifit 1.0 L ha^{-1} were equally effective than the other weed control treatments in controlling weeds and in producing higher yield of grain.

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