RESEARCH PAPER

ADVANCE RESEARCH JOURNAL OF
CROP IMPROVEMENT
Volume 7 | Issue 1 | June, 2016 | 72-75
e ISSN-2231-640X

DOI :
10.15740/HAS/ARJCI/7.1/72-75
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# Effect of weed management techniques on weeds, yield and economics on rice based cropping systems

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**ABSTRACT :** A field experiment was conducted at the Agronomy Research Farm of Narendra Deva University of Agriculture and Technology, Kumarganj, Faizabad (U.P.) during two consecutive crop seasons of 2008-09 and 2009-10. The experiment was laid out in Split Plot Design with three replications. The twelve treatment combinations comprised of six cropping systems *viz*., rice-wheat, rice-chickpea, rice-fieldpea, rice-mustard, rice-linseed, rice-berseem, were kept in main plots and two weed control treatments *viz*., two hand weeding (20 and 40 DAS) and weedy check in rice crop and one hand weeding at 30 DAS and weedy in *Rabi* crops were kept in sup- plots. The hand weeding was done with the help of *Khurpi*. In rice crop lower weed density was recorded in rice-chickpea cropping system followed by rice-wheat cropping system at all the stages of crop growth during both the years. Significantly lower weed dry weight was recorded in rice-mustard cropping system as compared to other cropping system at all the stages of crop growth during both the years. Application of 2 HW (20 and 45 DAS) gave highest grain yield of 44.42 q /ha$^{-1}$ in rice- berseem cropping system during first year and 43.40q/ ha$^{-1}$ in rice-chickpea during second year. The lowest grain yield of 12.32 and 14.30 q / ha$^{-1}$ was obtained in weedy plot of rice-fieldpea cropping system during respective years. In *Rabi* crops significantly lower weed density and dry weight was recorded in one hand weeding compared to weedy check plot at all the stages of crop growth during both the years.

**KEY WORDS :** Weed density, Yield, Economics, Cropping system

**How to cite this paper :** Nishad, Kamlesh Kumar, Singh, Ghanshyam, Kumar, Binod, Singh, Govind and Kumar, Rajesh (2016). Effect of weed management techniques on weeds, yield and economics on rice based cropping systems. *Adv. Res. J. Crop Improv.,* **7**(1):72-75, **DOI : 10.15740/HAS/ARJCI/7.1/72-75**.

**Paper History : Received :** 16.01.2016; **Revised :** 07.04.2016; **Accepted :** 06.05.2016

The cropping system is highly specific and in strict sense it varies from region to region but in broader sense cropping system of region are decided by and large by a soil and climate parameters for nourishment and appropriation of a crop or set of crops for cultivation. Rice based cropping system is a major cropping system of the Indian subcontinent and China. Rice-wheat system covers about 10.5 mha. area in India and a backbone of country's food security with a yield potential of 8.12 tons/ha/year (Singh *et al*., 2007). The prolonged cultivation of rice and wheat in rice-wheat system, weed species especially the grassy weeds in both the crops especially in rice have increased to a greater extent. Nevertheless, with diversification of the system, the behaviour of weeds in rice as function of preceding *Rabi* crop may change. Among the different weed management practices, mechanical weeding is still very popular among the different crops especially in *Rabi* crops, may be due to

discouragement of chemical herbicide use and in organic farming system also. In rice-wheat system, yield reduction in rice has been reported to the extent of 45 per cent and in wheat 35 per cent depending upon the soil type and rainfall pattern of a popular area. The diversification of the system has resulted in increased profit and sustained productivity.

## RESEARCH PROCEDURE

The experiment on effect of rice based cropping system on weed dynamics and crop productivity was conducted during crop season of 2008-09and 2009-10 at Agronomy Research Farm of Narendra Deva University of Agriculture and Technology, Narendra Nagar (Kumarganj), Faizabad(U.P.).The research farm is located 42 km away from Faizabad district head quarter on Faizabad–Raibarelly state highway. Geographically Faizabad falls under sub-tropical climate zone of Indo-Gangetic alluvium of eastern Uttar Pradesh. The experimental site is situated at about 26.49$^0$N latitude and 82.12$^0$E longitude and an altitude of 113 meters above from mean sea level. The climate of the district is semi arid with hot summer and cold winter. This region receives an average annual rainfall of about 1280 mm which is critically distributed. Nearly 80 per cent of the total rainfall is received during monsoon from July to end of September. The soil of the experimental field was silt loam in texture with slightly alkaline in reaction (pH 8.21) having low organic carbon (0.35%) and available nitrogen (115.40kg ha$^{-1}$), medium in phosphorus (15.0kg ha$^{-1}$) and higher in available potassium (245.47kg ha$^{-1}$). The land was ploughed by tractor drawn plough, one ploughing by soil turning plough and twice by cultivator was done in the second week of June for rice crop. For *Rabi* crop a pre-sowing irrigation (Paleva) was done in the experimental field with an object to get optimum moisture conditions for attaining good germination. At proper tilth, one ploughing with tractor drawn mould bold plough was done followed by two ploughings by cultivator. Weed and stubbles of previous crop were removed from the field. The planking was done invariably after each ploughing. The layout was done carefully before the sowing of crop.

## RESEARCH ANALYSIS AND REASONING

At 60 DAS stage significantly lower weed density

**Table 1 : Weed density at 60 DAS in *Rabi* crops under rice based cropping system**

| Treatments | *P. minor* | | *C. album* | | *V.sativa* | | *M.indica* | | *Rumex*.spp. | | Others | | Total | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2008 | 2009 | 2008 | 2009 | 2008 | 2009 | 2008 | 2009 | 2008 | 2009 | 2008 | 2009 | 2008 | 2009 |
| **Mainplot (Cropping system)** | | | | | | | | | | | | | | |
| Rice-wheat | 4.11 (16.97) | 3.80 (14.50) | 4.03 (16.31) | 3.19 (10.19) | 2.38 (5.67) | 1.76 (3.13) | 3.99 (15.50) | 3.24 (10.75) | 2.21 (4.50) | 1.77 (2.80) | 1.74 (2.56) | 0.71 (0.00) | 7.37 (54.83) | 6.65 (45.03) |
| Rice-chickpea | 4.22 (17.88) | 3.44 (11.86) | 3.50 (12.31) | 2.69 (7.24) | 4.61 (21.30) | 3.97 (15.77) | 2.89 (8.40) | 2.04 (4.20) | 1.73 (3.00) | 1.22 (1.50) | 0.71 (0.00) | 0.71 (0.00) | 7.13 (50.87) | 6.60 (43.58) |
| Rice-fieldpea | 4.28 (18.86) | 3.51 (12.35) | 3.69 (13.66) | 3.25 (10.62) | 4.59 (21.10) | 4.24 (18.05) | 3.40 (11.56) | 2.48 (6.18) | 2.19 (4.80) | 1.80 (3.26) | 1.45 (1.66) | 1.26 (1.09) | 7.72 (60.59) | 7.51 (57.49) |
| Rice-mustard | 4.39 (19.31) | 3.56 (12.70) | 3.59 (12.91) | 2.93 (8.62) | 4.33 (18.75) | 3.87 (15.05) | 3.62 (13.17) | 2.91 (8.49) | 1.40 (1.50) | 1.40 (1.40) | 0.71 (0.00) | 0.71 (0.00) | 7.56 (57.18) | 7.19 (51.81) |
| Rice-linseed | 4.28 (18.40) | 3.60 (13.03) | 4.05 (16.41) | 3.17 (10.07) | 4.61 (21.26) | 4.00 (16.00) | 4.70 (22.13) | 4.13 (17.10) | 2.36 (5.60) | 1.70 (3.00) | 2.10 (4.45) | 1.54 (2.38) | 8.45 (71.94) | 8.31 (69.52) |
| Rice-berseem | 2.68 (7.19) | 2.15 (4.64) | 2.55 (6.53) | 1.87 (3.51) | 0.71 (0.00) | 0.71 (0.00) | 1.89 (3.59) | 1.24 (1.56) | 3.01 (9.07) | 2.20 (4.86) | 1.01 (0.61) | 0.99 (0.56) | 4.72 (22.36) | 4.09 (16.75) |
| S.E.± | 0.10 | 0.10 | 0.09 | 0.09 | 0.11 | 0.11 | 0.08 | 0.09 | 0.05 | 0.05 | 0.03 | 0.02 | 0.21 | 0.21 |
| L.S.D. (P=0.05 ) | 0.34 | 0.32 | 0.29 | 0.29 | 0.30 | 0.36 | 0.27 | 0.29 | 0.17 | 0.16 | 0.10 | 0.08 | 0.68 | 0.66 |
| **Subplot (weed management)** | | | | | | | | | | | | | | |
| Hand weeding | 3.68 (13.56) | 2.96 (8.80) | 3.06 (9.41) | 2.47( 6.14) | 3.48 (12.17) | 2.86 (8.21) | 3.40 (9.40) | 2.37 (5.62) | 1.89 (3.60) | 1.22 (1.50) | 1.09 (0.85) | 0.94 (.051) | 6.14 (38.95) | 5.83 (35.85) |
| Weedy check | 4.37 (19.16) | 3.76 (14.20) | 3.95 (15.63) | 3.40 (11.61) | 4.39 (19.28) | 3.53 (12.50) | 3.56 (13.13) | 3.41 (12.05) | 2.34 (5.22) | 2.22 (4.64) | 1.39 (1.74) | 1.12 (1.00) | 7.92 (64.05) | 7.71 (60.80) |
| S.E.± | 0.06 | 0.05 | 0.05 | 0.05 | 0.06 | 0.06 | 0.05 | 0.05 | 0.03 | 0.03 | 0.01 | 0.01 | 0.12 | 0.12 |
| L.S.D. (P=0.05 ) | 0.19 | 0.18 | 0.16 | 0.16 | 0.20 | 0.20 | 0.15 | 0.16 | 0.09 | 0.09 | 0.05 | 0.05 | 0.38 | 0.37 |

was recorded under rice-barseem cropping system over rice- wheat, rice-chickpea, rice-fieldpea, rice-mustard and rice-linseed cropping systems during both the years.Weed management practices affected the population of different weed species at 60 DAS. One hand weeding recorded significantly lower weed density as compared to weedy check for all the species during both the years. One hand weeding treatment recorded higher number of ears running meter$^{-1}$, spike length (cm), no. of spikelets spike$^{-1}$, number. of grains spike$^{-1}$, test weight (g), grain yield (q/ha$^{-1}$), straw yield (q/ha$^{-1}$) and harvest index over weedy check plots during both the years. It was probably due to effective weed control under one hand weeding, which led to less competition for growth and development of crop plants resulting more yield and yield attributes.Tomar *et al.* (2003) reported

**Table 2 : Yield and harvest index of various *Rabi* crops in rice based cropping system**

| Crops | | Grain yield (q/ha$^{-1}$) | | Fodder yield (q/ha$^{-1}$) | | Straw/ stover yield (q/ha$^{-1}$) | | Biological yield (q/ha$^{-1}$) | | Harvest index (%) | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 2008-09 | 2009-10 | 2008-09 | 2009-10 | 2008-09 | 2009-10 | 2008-09 | 2009-10 | 2008-09 | 2009-10 |
| Wheat | 1HW | 40.04 | 41.08 | | | 59.00 | 58.10 | 100.04 | 99.18 | 40.87 | 41.41 |
| | weedy | 32.02 | 33.10 | | | 47.98 | 48.02 | 80.00 | 81.12 | 40.02 | 40.80 |
| Chickpea | 1HW | 13.12 | 14.30 | | | 27.51 | 28.05 | 41.79 | 42.35 | 31.39 | 33.76 |
| | weedy | 7.62 | 8.80 | | | 16.20 | 16.05 | 23.82 | 23.85 | 31.98 | 36.89 |
| Fieldpea | 1HW | 23.96 | 24.11 | | | 28.65 | 30.34 | 52.61 | 54.45 | 45.54 | 44.27 |
| | weedy | 10.82 | 11.20 | | | 18.43 | 19.10 | 29.25 | 30.30 | 36.99 | 36.96 |
| Mustard | 1HW | 13.66 | 14.10 | | | 51.05 | 55.02 | 64.71 | 69.12 | 21.10 | 21.00 |
| | weedy | 8.12 | 9.35 | | | 36.10 | 41.30 | 44.22 | 50.65 | 18.36 | 18.46 |
| Linseed | 1HW | 12.18 | 13.10 | | | 15.10 | 16.30 | 27.28 | 29.40 | 44.64 | 44.55 |
| | weedy | 7.50 | 8.75 | | | 11.25 | 11.45 | 18.75 | 20.20 | 40.00 | 43.31 |
| Berseem | 1HW | 5.00 | 5.10 | 490.84 | 500.00 | | | | | | |
| | weedy | 3.80 | 3.85 | 380.00 | 390.12 | | | | | | |

**Table 3 : Economics of different treatments**

| Treatments | Cost of cultivation (Rs.ha$^{-1}$) | | Gross return (Rs.ha$^{-1}$) | | Net return (Rs.ha$^{-1}$) | | B-C ratio (Rs. re$^{-1}$) | |
|---|---|---|---|---|---|---|---|---|
| | 2008-09 | 2009-10 | 2008-09 | 2009-10 | 2008-09 | 2009-10 | 2008-09 | 2009-10 |
| **Rice -wheat** | | | | | | | | |
| H.W. | 25498.00 | 27440.00 | 86978.00 | 95100.00 | 61480.00 | 67660.00 | 2.41 | 2.46 |
| Weedy | 23998.00 | 25940.00 | 54785.00 | 66101.00 | 30778.00 | 40161.00 | 1.28 | 1.54 |
| **Rice -chickpea** | | | | | | | | |
| H.W. | 22471.00 | 24313.00 | 69631.00 | 80296.00 | 47160.00 | 55983.00 | 2.09 | 2.30 |
| Weedy | 20971.00 | 22813.00 | 31614.00 | 41534.50 | 10643.00 | 18721.00 | 0.51 | 0.82 |
| **Rice - fieldpea** | | | | | | | | |
| H.W. | 22521.00 | 24063.00 | 75641.00 | 80820.40 | 53120.00 | 56757.00 | 2.35 | 2.36 |
| Weedy | 21021.00 | 22563.00 | 29011.00 | 34526.50 | 7990.00 | 11963.00 | 0.38 | 0.53 |
| **Rice –mustard** | | | | | | | | |
| H.W. | 24078.0 | 25420.00 | 61113.00 | 67669.00 | 37035.00 | 42249.00 | 1.53 | 1.66 |
| Weedy | 22578.00 | 23920.00 | 30457.00 | 34067.00 | 7879.00 | 10147.00 | 0.34 | 0.42 |
| **Rice –linseed** | | | | | | | | |
| H.W. | 21613.00 | 23055.00 | 61976.00 | 67925.00 | 40363.00 | 44870.00 | 1.86 | 1.94 |
| Weedy | 20113.00 | 21555.00 | 29934.00 | 36056.00 | 9821.00 | 14501.00 | 0.48 | 0.67 |
| **Rice –berseem** | | | | | | | | |
| H.W. | 21353.00 | 22595.00 | 99620.00 | 113106.25 | 78267.00 | 90511.25 | 3.66 | 4.00 |
| Weedy | 19853.00 | 21095.00 | 62704.00 | 75480.00 | 42851.00 | 54385.00 | 2.15 | 2.57 |

that weed growth (biomass and population) was significantly affected by weed management practices. Maximum grain yield (4.72 t/ha) was obtained with two hand weeding, which was significantly higher than herbicides alone (4.09 t/ha) (Table 1). One hand weeding treatments recorded higher number of siliquae plant$^{-1}$, length of siliqua (cm), number of seeds siliqua$^{-1}$, test weight (g), grain yield (q/ha$^{-1}$), stover yield (q/ha$^{-1}$) and harvest index over weedy check plots during both the years. In fact, one hand weeding treatment was found effective to reduce both the weed density and dry weight per unit area due to which there was no or very less competition between crop and weeds for different growth factor which provided congenial conditions to the crop for its proper development of reproductive phase. Pandey and Mishra (2003) reported that weed control treatments caused a significant increase in grain yield of oil seed crops in both years. Cultural and hand weeding caused a significant increase in grain yield of mustard and mung bean. One hand weeding treatments recorded higher green fodder yield (q/ha$^{-1}$) and seed yield (q/ha$^{-1}$), as compared to weedy check plot during both the years. All the growth and yield contributing characters were found better under the effect of hand weeding treatment, which ultimately resulted in to higher yield of fodder and seed.

Maximum cost of cultivation *i.e.* Rs. 25498.00 and 27440.00 ha$^{-1}$ was observed during respective years in rice-wheat cropping system with the one hand weeding treatment, compared to weedy check plot (Table 3). It might be due to more cost of seed of wheat and labour charges. The minimum cost of cultivation *i.e.* Rs. 21353.00 and 22595.00 ha$^{-1}$ was recorded during first year and second year, respectively in rice-barseem cropping system. The highest gross return Rs. 99620.00 and 113106.25 ha$^{-1}$ was obtained during first and second year, respectively under rice-barseem cropping system, while lowest gross return of Rs. 61113.00 and 67669.00 ha$^{-1}$ was recorded during first year and second year, respectively under rice-mustard cropping system. The maximum net return of Rs.78267.00 and 90511.25 ha$^{-1}$ was obtained under rice-barseem cropping system, while minimum net return *i.e.* Rs.37035.00 and 42249.00 ha$^{-1}$ was recorded during rice-mustard cropping system during first year and second year, respectively. The highest benefit-cost ratio (Rs. 3.66 and 4.00 re$^{-1}$) was recorded in rice-barseem cropping system while, minimum B-C ratio (Rs. 1.53 and 1.66 re$^{-1}$) was recorded under rice-mustard cropping system. Tripathi and Singh (2008) observed that Maximum sustainable value index SVI (0.92) and net returns (Rs. 38.6x10$^3$/ ha/year) were recorded in rice-Indian mustard-green gram-rice-wheat-green gram-rice-wheat-green gram crop sequence. Benefit:cost ratio (1.74) and profitability (Rs. 124/ha/day) were highest in pigeonpea-wheat-rice-wheat-rice-wheat crop sequence. Similar result was also reported by Kumar and Faruqui (2009); Hanif *et al.*, 2010 in chickpea, Laskar *et al.*, 2005 in rice-based intercropping system.

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