Journal of Applied and Natural Science 8 (2): 663 - 667 (2016)

JANS

Chemical weed management in *Brassica rapa* var. yellow sarson

S. K. Das

AICRP on Potato, Directorate of Research, Bidhan Chandra Krishi Viswavidyalaya, Kalyani- 741235, Nadia (West Bengal), INDIA
Email: sanjibag@gmail.com

Received: September 9, 2015; Revised received: January 24, 2016; Accepted: April 26, 2016

Abstract: Field experiments were conducted for three years at Pulses and Oilseeds Research Station, Berhampore, Murshidabad, West Bengal, India during *rabi* 2008, 2009 and 2010 to develop an efficient chemical weed management practice with newer herbicidal molecules in yellow sarson. The experiment was laid out in a randomized block design with three replications having eleven treatments. Experimental results revealed that highest seed yield (1456 kg ha^{-1}) was recorded under the treatment twice hand weeding and lowest with weedy check (910 kg ha^{-1}). Twice hand weeding recorded 60% higher seed yield over weedy check. Application of chemical herbicides significantly improved the seed yield over W_0 at 5% level of significance.. Among the chemical weed control measures, application of Pendimathalin @ 1 kg a.i./ha (PE) recorded highest seed yield (1320 kg ha^{-1}) of yellow sarson, which was found at par with application of Pendimathalin @ 1.5 kg a.i./ha (PE), Fluchloralin @ 1.5 kg a.i/ha (PPI) and Clodinafop @ 0.06 kg a.i./ha (25-30 DAS). Chemical weed management practices increased the seed yield of yellow sarson by 25.3 to 45.1% over weedy check. Highest weed control efficiency (86.4%) was recorded with hand weeding twice. Significant reduction in the total weed density and total weed dry weight were found with the application of chemical herbicides at 5% level of significance. Among the chemical herbicides Pendimathalin @ 1 kg a.i./ha (PE) recorded highest weed control efficiency (81.7%). Chemical weed control measures increased the total microbial population by 26.5 to 89.4% over weedy check and 6.6 to 59.6% over twice hand weeding and thus proved to be environmentally safe and economic for managing weeds in yellow sarson.

Keywords: Chemical weed management, Microbial population, Seed yield, Weed control efficiency, Yellow sarson

INTRODUCTION

Rapeseed-mustard is an important group of edible oil-seed crops in India. Among the seven edible oilseed cultivated in India, rapeseed-mustard (Brassica spp.) contributes 28.6% in the total production of oilseeds. In India, it is the second most important edible oilseed after groundnut sharing 27.8% in the India's oilseed economy (Shekhawat *et. al.*, 2012). Technological advancement in rapeseed-mustard production has resulted in increased productivity. But many biotic stresses such as weeds cause severe yield losses up to 45% in rapeseed-mustard (Singh *et. al.*, 2013). The critical period of crop - weed competition is early growth stages especially between 15–40 days after sowing (Shekhawat *et. al.*, 2012; Singh *et. al.*, 2013). Weeds compete with crop plants for water, light, space, and nutrients. Therefore, timely and appropriate weed control greatly increases the crop yield and thus nutrient use efficiency. The common weeds of rapeseed- mustard are *Chenopodium album*, *C. murale*, *Cyperus rotundas*, *Cynodon dactylon*, *Melilotus alba*, *Asphodelus tenuifolius*, *Orobanche* spp. and *Anagallis arvensis*. The weed management in mustard is done by both cultural and herbicidal approaches. Since hand weeding and other weed control methods are laborious, time consuming, costly and difficult, chemicals are the obvious and cost effective methods of weed control that can increase the profit and weed control efficiency. The chemical weed control method is becoming popular among the farmers as they continue to realize the usefulness of herbicides.Therefore, the present experiment was initiated with the objective to develop a suitable and effective chemical weed management practice for managing weeds in yellow sarson to maximize the productivity of rapeseed oil and thereby oil yield of the country India.

MATERIALS AND METHODS

Field experiments were conducted at Pulses and Oilseeds Research Station, Berhampore, Murshidabad, West Bengal, India situated at $24^0$60'N latitude, $88^0$15' E longitude at an elevation of 19.0 meters above the mean sea level (MSL) during *rabi* 2008, 2009 and 2010. Initial soil samples were collected randomly from different locations of the experimental area with the help of auger from 0-15 cm. soil depth. Those were then thoroughly mixed, dried in shade and sieved and the volume of soil samples to be analyzed were there after reduced using partitioning method. Those soil samples were then kept in polythene bags for mechani-

ISSN : 0974-9411 (Print), 2231-5209 (Online)

cal and chemical analysis. The soil of the experimental field was sandy loam in texture and slightly alkaline in reaction (pH 7.5) having an organic carbon content of 0.31%, 72 kg available P ha^{-1} and 110 kg available K ha^{-1}. The experiment was laid out in a randomized block design with three replications having eleven treatments *viz.* W_0 – Weedy check, W_1 – Twice hand weeding at 20& 40 DAS, W_2 – Fluchloralin @ 1.0 kg a.i/ha (PPI), W_3 – Fluchloralin @ 1.5 kg a.i/ha (PPI), W_4 – Pendimathalin @ 1 kg a.i./ha (PE), W_5 – Pendimathalin @ 1.5 kg a.i./ha (PE), W_6 – Oxadiazon @ 0.75 kg a.i./ha (PE), W_7 – Oxyfluorfen @ 0.15 kg a.i./ha(PE), W_8 – Quizalofop @ 0.06kg a.i./ha (25-30 DAS), W_9 – Clodinafop @ 0.06 kg a.i./ha (25-30 DAS) and W_{10} – Isoproturon @ 1.0 kg a.i./ha (P.E.) with a plot size of 4 m X 3 m. The yellow sarson variety used was Binoy (B-9) and the seed rate was 7.5 kg ha^{-1} with a spacing of 30 cm X 10 cm and sown on third week of October. The fertilizer applied was 100, 50, 50 kg N, P, K per ha. Half of the total nitrogen(N) and full dose of P and K were applied as basal in the form of urea, single super phosphate and muriate of potash and rest half of the N was applied 30 DAS (days after sowing). The herbicides were sprayed by using hand operated knapsack sprayer fitted with herbicide nozzle of ASPEE ULV 100. The spray volume used was 400L ha^{-1}. Density and dry weight of weed was recorded in a fixed square meter area at 50 DAS. Control efficiency was also calculated as suggested by Maity and Mukherjee (2011). Soil samples were collected from each treatment through proper method and from this representative soil sample of each treatment, 1g of field soil was measured by precision balance and then it was diluted up to 10^6 times by following serial dilution method as done by Elad *et al*. (1980), Baker (1968) and Naher (2013). Then this diluted soil was spreaded into the media plates to develop microbial colony. To enumerate total bacterial, fungal and actinomycetes population nutrient agar (NA), potato dextrose agar (PDA) and actinomycetes media plates were used, respectively. The number of CFU (Colony Forming Units) were counted 1DA (Day After) 3DA and 6DA by keeping the plates in incubator at 25-30^oC as done by Elad *et.al.*(1980), Baker (1968) and Naher (2013). The microbial population was expressed in terms of C.F.U. / g of soil. Data on yield attributes and seed yield (kg ha^{-1}) were recorded at harvest. Analysis of variance of the data in the experimental design and comparison of means at $p \leq 0.05$ were carried out, using MSTAT-C software.

RESULTS AND DISCUSSION

Effect on yield attributing characters and seed yield: Experimental results of the present study revealed that weed management practices significantly influenced the yield attributing characters and seed yield of yellow sarson variety B-9 (Binoy) at 5% level

Table 1. Effect of different weed management practices on yield attributing characters and yield of yellow sarson (pooled data of three years).

Treatment	Plant height (cm)	No. of primary branches $plant^{-1}$	No. of siliqua $plant^{-1}$	Number of seeds $siliqua^{-1}$	1000 seed weight (g)	Seed yield (kg ha^{-1})
W_0 – Weedy check	62.3	3.68	50.9	14.56	3.56	910
W_1 – Twice hand weeding at 20& 40 DAS	74.5	4.63	74.6	18.90	3.73	1456
W_2 – Fluchloralin @ 1.0 kg a.i/ha (PPI)	67.2	4.12	63.4	16.47	3.65	1222
W_3 – Fluchloralin @ 1.5 kg a.i/ha (PPI)	68.6	4.21	65.2	17.10	3.68	1275
W_4 – Pendimathalin @ 1 kg a.i./ha (PE)	70.6	4.30	67.6	17.42	3.71	1320
W_5 – Pendimathalin @ 1.5 kg a.i./ha(PE)	70.2	4.26	66.0	17.25	3.70	1304
W_6 – Oxadiazon @ 0.75 kg a.i./ha (PE)	66.1	4.06	62.1	16.37	3.60	1202
W_7 – Oxyfluorfen @ 0.15 kg a.i./ha(PE)	65.6	4.00	61.8	16.33	3.58	1192
W_8 – Quizalofop @ 0.06kg a.i./ha (25-30 DAS)	66.4	4.10	63.0	16.42	3.63	1218
W_9 – Clodinafop @ 0.06 kg a.i./ha (25-30 DAS)	68.0	4.18	64.7	16.62	3.67	1249
W_{10} – Isoproturon @ 1.0 kg a.i./ha (P.E.)	65.1	3.96	59.9	15.93	3.57	1140
SEm ±	1.1	0.1	1.0	0.3	0.1	27
CD (P=0.05)	3.3	0.3	3.0	0.9	NS	81

Table 2. Effect of different weed management practices on weed density, weed dry weight, weed control efficiency and total soil microbial population in yellow sarson (pooled data of three years).

Treatment	Weed density (No.m^{-2}) 50 DAS	Weed dry weight (g m^{-2}) 50DAS	Weed control efficiency(%)	Microbial population (CFU×10^{6} g^{-1} of soil) at harvest
W_0 – Weedy check	321.5	54.5	0.0	42.3
W_1 – Twice hand weeding at 20& 40 DAS	42.5	7.4	86.4	50.2
W_2 – Fluchloralin @ 1.0 kg a.i/ha (PPI)	138.6	22.5	58.7	58.6
W_3 – Fluchloralin @ 1.5 kg a.i/ha (PPI)	106.3	15.3	71.9	53.5
W_4 – Pendimathalin @ 1 kg a.i./ha (PE)	85.3	10.0	81.7	68.2
W_5 – Pendimathalin @ 1.5 kg a.i./ha(PE)	95.6	12.1	77.8	60.8
W_6 – Oxadiazon @ 0.75 kg a.i./ha (PE)	139.1	24.9	54.3	63.0
W_7 – Oxyfluorfen @ 0.15 kg a.i./ha(PE)	144.7	26.2	51.9	65.1
W_8 – Quizalofop @ 0.06kg a.i./ha (25-30 DAS)	132.4	23.8	56.3	72.5
W_9 – Clodinafop @ 0.06 kg a.i./ha (25-30 DAS)	125.8	18.0	67.0	80.1
W_{10} – Isoproturon @ 1.0 kg a.i./ha (P.E.)	164.9	29.8	45.3	53.6
SEm ±	13.8	0.8	-	9.0
CD (P=0.05)	41.5	2.4	-	26.8

of significance (Table 1). Based on the pooled value of three years, it was observed that highest plant height (74.5cm), number of primary branches per plant (4.63), number of siliqua per plant (74.6), number of seeds per siliqua (18.90), test weight (3.73 g) and seed yield (1456 kg ha^{-1}) was recorded under the treatment W_1 (Twice hand weeding).This might be due to adequate weed control during the cropping period, which provided maximum moisture and nutrients for healthy plant growth. Similar reason was also reported by Sultana *et al*., 2009 in mung bean crop. The lowest plant height (62.3 cm), number of primary branches per plant (3.68), number of siliqua per plant (50.9), number of seeds per siliqua (14.56), test weight (3.56 g) and seed yield (910 kg ha^{-1}) was recorded with weedy check (W_0) which was mainly due to heavy infestation of weeds. In the present study twice hand weeding recorded 60% higher seed yield over weedy check in yellow sarson. Application of chemical herbicides significantly improved the seed yield over W_0 at 5% level of significance. Among the chemical weed control measures, application of Pendimathalin @ 1 kg a.i./ha (PE) (W_4) recorded highest plant height (70.6 cm), number of primary branches per plant (4.30), number of siliqua per plant (67.6), number of seeds per siliqua (17.42), test weight (3.71 g) and seed yield (1320 kg ha^{-1}) of yellow sarson, which was found at par with application of Pendimathalin @ 1.5 kg a.i./ha (PE), Fluchloralin @ 1.5 kg a.i/ha (PPI) and Clodinafop @ 0.06 kg a.i./ha (25-30 DAS) mainly attributed to better weed control efficiency by reducing the weed density and weed dry weight with no harmful effect on yellow sarson plant. By using chemical herbicides in rapeseed -mustard similar results were also reported by Singh *et.al*. (2013) and in black gram similar results were also reported by Das *et.al*. (2014), Asaduzzaman *et.al*. (2010) and Mundra and Maliwal (2012). Chemical weed management practices increased the seed yield of yellow sarson by 25.3 to 45.1% over weedy check.

Effect on weed flora: In the present study, the experimental field of yellow sarson was dominated by natural infestation of broad leaf weed (BLW) like *Anagalis arvensis, Chenopodium album, Convolvulus arvensis, Fumaria parviflora, Melilotus alba, Lathyrus aphaca, Euphorbia hirta, Parthenium hysterophorus, Spergula arvensis, Gnaphalium leuteoalbum, Commelina benghalensis, Asphodelus tenuifolius, Cleom viscosa* and grasses like *Echinochloa colona*, *Cynodon dactylon*, *Paspalum scrobiculatum*, *Digitaria sanguinalis* and sedges like *Cyperus rotundus*. The maximum weed density (321.5 no.m^{-2}) and weed dry weight (54.5 gm^{-2}) were recorded in weedy check followed by Isoproturon @ 1.0 kg a.i./ha (P.E.) (164.9 no.m^{-2} and 29.8 gm^{-2}) (Table 2). The lowest weed density (42.5 no.m^{-2}) and weed dry weight (7.4 gm^{-2}) were recorded in hand weeding twice. Among the herbicides the lowest weed density (85.3 no.m^{-2}) and weed dry weight (10 gm^{-2}) were recorded under application of Pendimathalin @ 1 kg a.i./ha (PE) followed by application of Pendimathalin @ 1.5 kg a.i./ha (PE), Fluchloralin @ 1.5 kg a.i/ha (PPI) and Clodinafop @ 0.06 kg a.i./ha (25-30 DAS). Weed dry weight reflects the growth potential of the weeds and is a better indicator of its competitive ability with the crop plants. Un-weeded check recorded the highest weed growth and weed biomass. Highest weed control efficiency (86.4%) was recorded with hand weeding twice followed by application of Pendimathalin @ 1 kg a.i./ha (PE) (81.7%), Pendimathalin @ 1.5 kg a.i./ha (PE) (77.8%), Fluchloralin @ 1.5 kg a.i/ha (PPI) (71.9%) and Clodinafop @ 0.06 kg a.i./ha (25-30 DAS) (67%). Among the herbicides applied in the present study the lowest weed control efficiency was recorded under Isoproturon @ 1.0 kg a.i./ha (P.E.)(45.3%). In twice hand weeding treatment, hand weeding conducted at 20 DAS (days after sowing) effectively prevent or

control early emerged weeds in the field followed by hand weeding conducted at 40 DAS control the later emerged weeds as also reported by Yadav *et al*. (2004) in sesame. Among the chemical herbicides, applied at recommended doses, Pendimathalin @ 1 kg a.i./ha (PE) recorded highest weed control efficiency (81.7%) with significantly higher seed yield of yellow sarson at 5% level of significance.

Effect on total microbial population: Total microbial population was significantly influenced at 5% level of significance by weed management practices (Table 2). Highest microbial population (80.1×10^6 CFU g^{-1} of soil) at harvest was recorded with application of Clodinafop @ 0.06 kg a.i./ha (25-30 DAS) which was found at par with the application of other herbicides and lowest with weedy check (42.3×10^6 CFU g^{-1} of soil). The result was in conformity with the findings reported by Ali *et.al*. (2014) in pea. Twice hand weeding recorded significantly lower microbial population (50.2×10^6 CFU g^{-1} of soil) than chemical weed control measures at 5% level of significance. This was in conformity with the findings of Sapundjieva *et.al*. (2008) in pea at Bulgaria soil. Chemical weed control measures increased the total microbial population by 26.5 to 89.4% over weedy check and 6.6 to 59.6% over twice hand weeding, which might be due to the fact that initially total microbial population did not vary significantly in all the treatments but after herbicide application, they differ for a short period of time. Having the ability to degrade herbicides, microorganisms utilize them as a source of biogenic elements for their own physiological processes. As herbicides have toxic effects on microorganisms; they reduce their abundance, activity and consequently, the diversity of their communities before degradation. Immediately after application, the toxicity of herbicides is normally most severe as their concentration in soil is highest but with the advancement of time, microorganisms degraded the herbicides and their concentration gradually reduced up to half-life. After that, carbon released from degraded herbicide leads to an increase of the soil microflora population (Bera and Ghosh, 2013). Chemical herbicides generally stimulated and increased the soil fungi and actinomycetes population and reduced the bacterial population to some extent and increased the overall total microbial population. Ali *et.al*. (2014) reported that application of herbicides like MCPB, Bentazon, MCPB + Fluozifop-p-butyl., Bentazon+Fluozifop-p-butyl, Metribuzin, Flouzifop-pbutyl+ Metribuzin, Cycloxydin, and Sethoxydin in pea increased the population of soil fungi, with 4 to 10 times compared with control. The herbicides used showed no significant effects on nitrogen fixing bacteria. The effects of herbicides on soil bacteria and actinomycetes were different. The study showed the use of herbicides could influence the biological balance of soil microflora, which has an important role in soil fertility and microbial ecosystem. Similarly, Adil *et.al*. (2012) reported positive effect of herbicide oxyfluorfen on soil microbial population in loam and silt loam soil .

Conclusion

Thus, it can be concluded from the present study that though twice hand weeding at 20 and 40 DAS proved to be the best for managing weeds in yellow sarson to get highest yield, but it is time consuming, laborious, costly and also the availability of labour is a major problem at present, thus, chemical weed management practices through application of Pendimathalin @ 1 kg a.i./ha (PE) or Pendimathalin @ 1.5 kg a.i./ha (PE) or Fluchloralin @ 1.5 kg a.i/ha (PPI) or Clodinafop @ 0.06 kg a.i./ha (25-30 DAS) may be a suitable, effective and environmentally safe weed management practice for yellow sarson without any harmful effects on soil microbes if applied in proper time and in proper dose and there by the severe yield loss in rapeseed due to weeds can be managed economically and the overall edible oil production of the country India can be maximized.

ACKNOWLEDGEMENT

The author is thankful to Mr. P. Saha, Agronomist, Pulses and Oilseeds Research Station, Berhampore, W.B. India; Mr. M.P. Shrivastava, Ex- Joint Director of Agriculture (Pulses), Pulses and Oilseeds Research Station, Berhampore, W.B. India; Dr. P. Bhattacharya, Director of Agriculture, Govt. of West Bengal and Ex-officio Secretary, Jessop Buildings, Kolkata-1 for their valuable guidance and encouragement during the period of this research programme. The author is also thankful to Director of Research, Bidhan Chandra Krishi Viswavidyalaya, Kalyani, Nadia, W.B. India and Director, Central Research Institute For Jute and Allied Fibres, Nilganj, Barrackpore, W.B., India for providing necessary laboratory facility during the course of research work.

REFERENCES

Adil, A., Husaein, E.L., Afrah, T.,. Mohamed, M.A., Elsiddig, A., Sharif, M. and. Osman, A.G. (2012). Effects of Oxyfluorfen Herbicide on Microorganisms in loam and Silt loam Soils. *ResearchJournal of Enviromental Sciences*. 6: 134-145.

Ali, M., Zaid, M.M. and Yahya, S.F. (2014). The Effects of Post-Emergence Herbicides on Soil Microflora and Nitrogen Fixing Bacteria in Pea field. *International Journal of Chemical, Environmental & Biological Sciences.* 2 (1): 201-205.

Asaduzzaman, M., Sultana, S., Roy, T.S. and Masum, S.M. (2010). Weeding and plant spacing effects on the growth and yield of blackgram. *Bangladesh Research Publication J.* 4(1): 62-68.

Baker, R. (1968). Mechanisms of biological control of soil-borne pathogens. *Ann. Rev. Phytopathol*. 6:263-94.

Bera, S. and Ghosh, R.K. (2013). Soil physico-chemical

properties and microflora as influenced by bispyribac sodium 10% SC in transplanted kharif rice. *Rice Sci.* 20 (5): DOI: 10.1016/S1672-6308(13) 60148-1.

Das, R., Patra, B.C., Mandal, M.K. and Pathak, A. (2014). Integrated weed management in blackgram (*Vigna mungo*.) and its effect on soil microflora under sandy loam soil of west bengal, *The Bio Scan*. 9 (4): 1593-1596.

Elad, Y., Chet, I and Katan, J. (1980). *Phytopathology*. 70:119-121.

Maity, S.K. and Mukherjee, P.K. (2011). Effect of brown manuring on grain yield and nutrient use efficiency in dry direct seeded Kharif rice (*Oryza sativa* L.). *Indian J. Weed Science*. 43(1&2): 61-66.

Mundra, S.L. and Maliwal, P.L. (2012). Influence of quizalofop-ethyl on narrow-leaved weeds in blackgram and its residual effect on succeeding crops. *Indian Journal of Weed Science*. 44(4): 231–234.

Naher, U.A., Othman, R. and Panhwar, Q.A. (2013). Culturable total and beneficial microbial occurrences in long-term nutrient deficit wetland rice soil. *Australian Journal of Crop Science*. 7(12):1848-1853.

Sapundjieva, K., Kalinova, S., Kartalska, Y. and Naydenov, M. (2008). Influence of pendimethalin herbicide upon soil microflora. *Pochvoznanie, Agrokhimiya I Ekologiya*. 42: 49 55.

Shekhawat, K., Rathore, S.S., Premi, O.P., Kandpal, B.K. and Chauhan, J.S. (2012). Advances in agronomic management of Indian mustard (Brassica juncea L.): An overview. International journal of Agronomy. 2012, Article ID 408284, 14 pp. doi:10.1155/2012/408284.

Singh, R.K., Singh , R.P. and Singh, M.K. (2013). Weed Management in Rapeseed-mustard - A Review. *Agricultural Reviews.* 34(1): 36-49.

Sultana, S., Ulah, M.J., Karim, M.F., Asaduzzaman, M. (2009). Response of mungbean to integrated nitrogen and weed management. *American-Eurasian J. Agronomy*. 2(2): 104-08.

Yadav, S.S. (2004). Integrated weed management in sesame (*Sesamum indicum* L.) under rainfed conditions of Rajasthan. *Haryana J. Agronomy*. 20(1and2): 120-121.