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RESPONSE OF WEED MANAGEMENT PRACTICES ON BUCKWHEAT (*FAGOPYRUM ESCULENTUM* MOENCH) UNDER RAINFED CONDITION

BINOY CHHETRI

Regional Research Station (HZ), Uttar Banga Krishi Viswavidyalaya, Kalimpong, Darjeeling, West Bengal, India

ABSTRACT

This study was carried out to investigate the effect of integrated weed management practices on buckwheat (*Fagopyrum esculentum* M). Among the varying weed management practices, the highest plant height, number of cymes per plant and number of branch per plant was recorded under the hands weeding (twice) at 20 and 35 days after sowing (DAS). The highest yield attributes and yield was recorded in hands weeding twice at 20 and 35 days after sowing (DAS) followed by pre-emergence application of fluchloralin @ 2.22 lt.ha^{-1} and post-emergence application of glyphosate @ 2.50 lt. ha^{-1} at 20 days after sowing (DAS) produces higher yield compare to control whereas pre-emergence application of fluchloralin @ 2.22 lt. ha^{-1} followed by one hand weeding at 35 DAS produces seed yield comparable to hand weeding (twice) treatment. The gross return, net income and benefit: cost ratio of buckwheat under seven varying weed management practices indicated that the hand weeding twice at 20 and 35 DAS recorded highest economic returns over other weed control practices. It may be concluded that the two hand weeding twice at 20 and 35 days after sowing best for obtaining overall gain in cultivation of buckwheat.

KEYWORDS: Buckwheat, Weeds Management, Yield Attributes, Yield, quality

INTRODUCTION

Buckwheat (*Fagopyrum esculentum* Moench) is an annual, medicinal plant is a group of pseudo cereal that belongs to the *Polygonaceae* family. It is native to Centre of Asia and is cultivated in India, Germany, Austria and other countries (Bernath, 2000). India is one of the leading countries worldwide, blessed with rich and diverse heritage of cultural traditions and wealth of tradition knowledge system related to the use of plant species (Pant *et al.*, 2009) and it has been used both in food formulation and as traditional medicine (Marshal and Pomeranz, 1982).

Weeds are an important factor in the crop management and their presence causes stress in the crop production. Effective weed management is critical to maintaining agricultural productivity (Verma, 2014) as it can lead to billions of dollars in global crop losses annually (Srinivasarao *et al*., 2014). It is widely known that loss caused by weeds exceed the losses from any category of agricultural pests. Of the total annual loss of agricultural products from various pests in India, weeds accounts for 45%, insects 30%, diseases 20% and other pests 5% (Rao, 1983). Weeds pose a major threat to the productivity and difficult to cultivation of buckwheat due to weed competition (Sakaliene *et al*., 2000). However, herbicides one of the effective to control initial flush of weeds which usually remain out of reach of the other methods of weed control and also have been found quite effective in buckwheat (Rana *et al.*, 2003). Rather, herbicides should be looked upon as supplement to cultural, physical and other methods of weed control to obtain superior and more efficient and economical control of weeds than is possible with the existing methods alone. Moreover, weed management is to reduce the weed population to a level where their presence has no effect on the areas of economic use. Weed management

is the shifting of the crop-weed balance so that yield is not economically reduced (Altieri and Letourneau, 1982). It is considered on the basis of its economic, ecological and sociological consequences. This means that the choice of weed control methods not only depends on technical solutions but relies also on other criteria (Shaw 1982). To manage this problem, judicious and economic use of the herbicides could be an alternative to manual weeding, which is tedious and cumbersome. Therefore, there must have a long range strategy to predict and avoid potential weed problems in the future. Considering these mentioned reasons a study on integrated weed management practices on performance of buckwheat a neglected winter pseudo-cereal crop was carried out under Terai region of West Bengal.

MATERIALS AND METHOD

A field experiment was conducted during the winter season of 2013 and 2014 at the Instructional Farm of Uttar Banga Krishi Viswavidyalaya, Pundibari, Cooch Behar, and West Bengal, to evaluate the growth, yield and economics of buckwheat ((*Fagopyrum esculentum* M.)) under integrated weed management practices. The experimental field was laid out in Randomized Block Design, having seven (7) treatments with three (3) replications. The treatments consisted of pre-emergence application of fluchloralin @ 2.22 lt. ha^{-1} (T_1), post-emergence of application of glyphosate @ 2.50 lt. ha^{-1} (T_2), pre-emergence application of fluchloralin @ 2.22 lt. ha^{-1} + hand weeding (once at 35 DAS) (T_3), hoeing (twice) 20 and 35 DAS (T_4), hand weeding (twice) at 20 and 35 DAS (T_5), pre-emergence application of fluchloralin @ 2.22 lt. ha^{-1} combined with post- emergence application of glyphosate @ 2.50 lt. ha^{-1} (T_6) and unwedded control (T_7). The results were analyzed taking consideration of pre harvest parameters *viz*. plant height, number of cymes $plant^{-1}$ and number of branch $plant^{-1}$ whereas postharvest parameters viz. number of cymes $plant^{-1}$, number of seeds $cyme^{-1}$, test weight (g) (1000 seed weight), grain yield (q ha^{-1}), straw yield (q ha^{-1}) and harvest index (%). Quality parameters like seed protein content was determined by using Khejdal method (% protein = % nitrogen in seed x 6.25). Economic analysis is gross income (Rs. ha^{-1}), net income (Rs. ha^{-1}) and benefit: cost ratio. The data obtained from two years (2013 and 2014) studies were analyzed statistically following split- plot design as per the procedure given by Gomez and Gomez (1984).

RESULTS AND DISSCUSIONS

Effect of Treatments on Growth Parameters of Buckwheat

Plant height was significantly influenced by the weed management practices during both the years of experimentation. The highest plant height (71.07 and 73.97 cm at harvest) was recorded under hand weeding twice at 20 and 35 days after sowing compared to the other treatments. This might be due to reduced large number of weed population per unit area which decreases the competition of nutrients, space, moisture, light and effectively suppression of weeds which ultimately enhanced the plant height. One hand weeding, hoeing and integrated with pre-emergence application of herbicides significantly influenced the growth of crop (Brazikishor *et al*., 2015). The integrated weed management practices, the number of branches per plant kept on increasing till the last observation recorded at harvest. The number of branches per plant increased with the advancement of the crop age due to its growth and reached its maximum at harvest irrespective of the treatments tried (Table 1). The number of branches per plant and number of cymes per plant was found significant due to the effect of weed management practices. However, hand weeding twice (T_5) at 20 and 35 days after sowing (6.55 and 7.76 at harvest) recorded the highest number of branches per plant compared to the other treatments. This might be due to the availability of suitable micro environment for their growth during active vegetative and reproductive stage (Table 1).

Effect of Treatments on Yield Components of Buckwheat

The effect of treatments on yield attributes of buckwheat i.e. the number of cyme per plant at harvest, number of seeds per cyme and test weight. The number of cymes per plant recorded lesser value during first year compared to the second year of experiment. Lowest value of number of cymes per plant (21.55 and 23.19) was observed under unweeded control plot (T_7). This might be due to the stiff weed-crop competition in unweeded control plot which adversely affected vegetative vigour of the plant and was reflected on the number of cymes per plant (Table 1). The highest number of cymes per plant (37.20 and 42.38 at harvest) was recorded under hand weeding twice (T_5) followed by pre-emergence application (34.66 and 35.96) of fluchloralin along with one hand weeding at 35 DAS (T_3), pre and post- emergence application (34.39 and 35.11 at harvest) of herbicides i.e. fluchloralin @ 2.22 lt. ha^{-1} and glyphosate @ 2.50 lt. ha^{-1} respectively (T_6) and hoeing (33.34 and 33.40 at harvest) twice at 20 and 35 DAS (T_4) at all the stages of crop growth. This might be due to the light of lesser weed- crop competition in these treatments which encouraged vegetative vigour and improved crop growth duration, availability of soil moisture, absorption of nutrients by crops and better utilization of light which ultimately enhanced the number of cymes per plant (Table1). Number of seeds per cyme was recorded the lowest value (7.00 and 7.33 at harvest) in unweeded control plot (T_7) (Table 1). This might be due to the stiff weed- crop competition from early stage of crop growth to maturity of crop adversely affect vegetative as well as reproductive vigour of plant and these were reflected on the number of seeds per cyme. The highest (11.33 and 12.00 at harvest) number of seeds per cyme was recorded under hand weeding twice at 20 & 35 DAS (T_5) followed by pre-emergence (10.60 and 10.66 at harvest) application of fluchloralin combined with one hand weeding at 35 DAS (T_3) pre and post-emergence application (9.67 and 10.33 at harvest) of herbicides (T_6) and hoeing twice (8.33 and 8.67 at harvest) at 20 and 35 DAs (T_4) (Table 1). Lesser weed- crop competition throughout the period of crop growth resulted in fullest manifestations of all the plant parts during each of the development phases of the plant and produced more number of cymes per plant and more number of seeds per cyme. Similar results also reported by Rana *et al.* (2004). Hand weeding twice at 20 and 35 days after sowing (T_5) significantly recorded the highest (23.65 and 23.81) test weight during both the years of experimentation. However, unweeded control (17.04 and 17.08) plot (T_7) showed the poorest performance with regard to test weight due to severe crop- weed competition from early stage of crop growth to maturity of the crop which adversely affect vegetative as well as reproductive vigour of plant and these was reflected on the test weight of seeds (Table 1).

Effect of Treatment on Seed, Stem and Harvest Index of Buckwheat

The seed yield of buckwheat significantly increases yield per hectare in second years compared to the first years of experimentation. Considering the overall effect on treatment, the seed yield of buckwheat for the second year was 0.61 quintal more than that of the first year. This was probably due to the prevailing of climatic condition during the cropping period. This might be due to the second year crop received a good amount of rainfall during seed filling stage and low minimum temperature and bright sunshine hours during the entire crop growth period. Congenial atmospheric condition during the early stage of crop growth and seed filling stage might have laid to higher production of buckwheat seed in the second year. However, highest seed yield (9.62 and 10.49 q ha^{-1}) was recorded under hand weeding twice at 20 and 35 days after sowing (T_5). The lowest seed yield (5.00 and 5.25 q ha^{-1}) was recorded under unweeded control (T_7) during both the years of experimentation. This was due to heavy infestation and rank growth of weeds in unweeded control. Hoeing twice at 20 and 35 DAS (T_4) recorded higher seed yield compared to the herbicidal treatment when applied alone (T_1 and T_2). Application of herbicide significantly reduced the weed infestation on buckwheat which ultimately increases the grain

yield (Garbar and Bulivan, 2003). Stem yield of buckwheat was significantly influenced the different weed management practices. The maximum stem yield (16.00 and 17.06 q ha^{-1}) was obtained under hand weeding twice (T_5) followed by pre-emergence application of fluchloralin along with one hand weeding (15.65 and 16.25 q ha^{-1}) (T_3) and pre-emergence and post-emergence application of fluchloralin and glyphosate (15.05 and 16.05 q ha^{-1}) (T_6) and hoeing twice (14.88 and 16.15 q ha^{-1}) (T_4). This might be due to the increases the growth and yield components of buckwheat which ultimately reflect the stem yield. However, the lowest value of stem yield was recorded under unweeded control (12.79 and 13.00 q ha^{-1}) (T_7). The pre-emergence application of herbicide *viz.* chloridazon significantly increases the straw yield and effectively control of weeds (Kavoliunaite and Salna, 2003). Harvest index reflects the partitioning of photosynthetic between the grain and the vegetative plant, and improvement in the harvest index emphasizes the importance of carbon allocation for grain production. The weed management practices significantly influenced the harvest index of buckwheat. However, the highest value of harvest index (38.60 and 39.13%) was observed when hand weeding was done at 20 and 35 DAS (T_5) compared to other treatments. The lowest value of harvest index was recorded under unweeded control (28.10 and 28.76%) (T_7).

Effect of Treatments on Protein and Carbohydrate of Buckwheat

Quality parameters viz. protein and carbohydrate of buckwheat significantly influenced by weed management practices during both the year of experimentation. However, the highest (14.55 and 14.61) was recorded under hand weeding twice at 20 and 35 days after sowing (T_5). This might be due the reduced the weed infestation during vegetative, reproductive and grain filling stage which enhanced the absorption of macro and micro nutrients ultimately increases the protein content in grain. The lowest protein content (13.07 and 13.55) was recorded under unweeded control (T_7) (Table 2). Heavy infestation of weeds at all stages of crop growth which reduces the protein content due to the higher competition of nutrients and light. The highest carbohydrate (64.55 and 64.59) was recorded under hand weeding twice at 20 and 35 days after sowing compared to the other weed management practices. However the lowest value (63.66 and 63.75) of carbohydrate was recorded under control plot (T_7). Similar results also reported by Sobhani *et al*. (2012) and Rahimic and Gadzo (2012).

Effect of Treatments on Economics of Buckwheat

Different weed management practices, the highest gross income (Rs. 18,090) was under hand weeding twice (T_5) followed by pre-emergence application of fluchloralin along with one hand weeding (Rs. 16434) (T_3) and pre and post-emergence application of fluchloralin and glyphosate (Rs. 15,984) (T_6). The lowest (Rs. 9,216) gross income was recorded under unweeded control plot (T_7). Net income was also influenced by different weed control practices (Table 3). The maximum net income (Rs. 11,491) was recorded under hand weeding twice (T_5) and thus could be attributed to highest seed yield in buckwheat. The minimum net income (Rs. 3937) was in unweeded control plot (T_7) might be due to the lowest seed yield of buckwheat. Benefit: cost ratio was the highest under hand weeding twice (T_5) (2.74) because of higher net return which was followed by T_4 (2.42), T_3 (2.33) and T_6 (2.19). Under T_4 (Hoeing twice) treatment the benefit: cost ratio was higher than the T_3 and T_6 treatments even then these treatments have higher yields compared to T_4. Application of herbicide *viz*. Betanal AM significantly increases the grain yield which ultimately enhanced the economic returns of buckwheat as reported by Kavoliunaite and Salna (2003a).

CONCLUSIONS

The integrated weed management practices hand weeding twice at 20 and 35 DAS (T_5) recorded the highest growth, yield, quality and economic returns compared to the other treatments. Hand weeding twice produced higher seed yield as compared to other treatments and it involved the highest manual labour cost for weed control which ultimately increased the cost of cultivation and resulted less benefit to the farmers. To achieve the increased production of buckwheat seed yield with higher net return per hectare, hand weeding twice at 20 and 35 DAS found to be the best treatment as compared to others treatments tried.

REFERENCES

1. Altieri, M.A. and Letourneau, D.K. (1982). Vegetation Management and Biological Control in Agro-Ecosystem: *Ecological Approaches*. pp. 1-6.
2. Bernath, J. (2000): Medicinal and Aromatic Plants (in Hungarian) *Mezo. Publ*. Budapest.
3. Brajkishor, P., Thangjam, C. S., Pravamanjari, G. and Kewalanand, (2015). Efficacy of herbicides for weed management in berseem.*The Bioscan*. 10(1): 347-350.
4. Garbar, G.L and Bulavin, L.A. (2003). Influence of ploughing time and herbicides on buckwheat yield. *Zashichita-Rastenii*. (27): 75-78.
5. Gomez, K.A. and Gomez, A.A. (1984). *Statistical Procedures for Agricultural Research,* edn 2, An International Rice Research Institute Book. Wiley-Inter-Science Publication, John Wiley & Sons, New York.
6. Kavoliunaite, I. and Salna, A. (2003). Optimization of weed control in buckwheat with different dose rates of Pyramin Turbo. *Zemdirbyste, Mokslo Darba*. 82: 114-125.
7. Kavoliunaite, I. and Salna, A. (2003a). The respons of Buckwheat and weeds to dose rates of betanal AM. Zemdirbyste, Mokslo-Darba. 82: 126-136.
8. Marshall, H.G. and Y. Pomeranz (1982). Buckwheat: Description, breeding, production and, utilization. Pp. 157-210 in Advances in Cereal Science and Technology. Vol. 5.
9. Pant, S., Samant, S. S. and Arya, S.C. (2009)**.** Diversity and indigenous household remedies of the inhabitants surrounding Mornaula reserve forest in west Himalaya. *Indian Journal of Traditional Knowledge*. 8 (4), 606- 610.
10. Pomeranz, ed.). American Association of Cereal Chemists Incorporated, St. Paul, Minnesota.
11. Rahimic, A. and Gadzo, D. (2012). The influence of the location and sowing term on the yield and qualitative properties of buckwheat. Radovi Poljoprivrednog Fakulteta Univerzitetau Sarajevu Works of the Faculty of Agriculture University of Sarajevo. 57(62(1)): 15-27.
12. Rana, S.S., Mondal, K.K., Pakaj, Sood and Rajinder Pal (2003). A preliminary study on the herbicidal weed control in buckwheat. *Fagopyrum*-2003; 20:81-84.
13. Rana, S. Singh, Pankaj Sood and Man Chand Rana (2004). Integrated weed management in buckwheat.

Fagopyrum. 21: 108-113.

14. Rao, V.S. (1983). Principles of Weeds Science. Oxford and IBH Publishing Co., New Delhi. pp 23-42.
15. Sakaliene, O., Salna, A., Metspalu, L. (ed.), Mitt, S. (2000). Evaluation of the bioefficacy of herbicides in buckwheat crop. *Transactions of the Estonian Agricultural University*, Agronomy. 2000; No. (209):175-177.
16. Shaw, W. C. (1982). *Weed Science Suppl*. 30:2-12.
17. Srinivasarao, M., Halder, A. and Pramanick, M. (2014). Efficacy of glyphosate 71% sg (ammonium salt) on weed management in tea. *The Ecoscan*. 6: 91-95.
18. Sobhani,M. R., Rahmikhdoev, G., Mazaheri, D. and Majidian, M. (2012). The effect of sowing date, pattern of planting and nitrogen on quantitative and qualitative yield in summer sowing buckwheat (*Fagopyrum esculentum* Moench). *Advances in Environmental Biology.* 6**(1)**: 440-446.
19. Verma, S. K. (2014). Enhancing sustainability in wheat production though irrigation regimes and weed management practices in eastern Uttar Pradesh. *The Ecoscan*. 6:115-119.

APPENDICES

Table 1: Effect of Treatments of Growth and Yield Attributes of Buckwheat

Treatment	Plant height [at Harvest (cm)]		Cyme Plant^{-1} (at Harvest)		Branch Plant^{-1} (at Harvest)		Seeds Cyme^{-1} (at Harvest)		Test Weight (g)	
	Y_1	Y_2	Y_1	Y_2	Y_1	Y_2	Y_1	Y_2	Y_1	Y_2
T_1	**62.50**	63.75	**31.88**	32.15	**4.52**	5.01	**7.67**	7.99	**19.29**	19.53
T_2	**62.44**	65.37	**32.09**	32.37	**4.85**	5.29	**8.00**	8.33	**20.05**	20.32
T_3	**66.30**	68.53	**34.66**	35.96	**6.11**	6.78	**10.60**	10.66	**22.64**	22.91
T_4	**65.81**	65.92	**33.34**	33.40	**5.08**	5.91	**8.33**	8.67	**20.77**	20.97
T_5	**71.07**	73.97	**37.20**	42.38	**6.55**	7.76	**11.33**	12.00	**23.65**	23.81
T_6	**62.79**	67.50	**34.39**	35.11	**5.64**	5.97	**9.67**	10.33	**21.44**	21.85
T_7	**43.72**	48.81	**21.55**	23.19	**3.21**	3.85	**7.00**	7.33	**17.04**	17.08
S.E m (±)	**0.96**	**0.64**	**1.77**	**0.60**	**1.11**	**0.74**	**0.42**	**0.44**	**0.34**	**0.29**
C. D. (P = 0.05)	**2.97**	**1.97**	**5.45**	**1.85**	**3.41**	**3.01**	**1.31**	**1.36**	**1.04**	**0.88**

Y_1 = 2013 and Y_2 = 2014

Table 2: Effect of Treatments on Seed Yield, Stem Yield, Harvest Index, Protein Carbohydrate and Economics of Buckwheat

Treatment	Seed yield (q ha^{-1})		Stem yield (q ha^{-1})		Harvest index (%)		Protein (%)		Carbohydrate (%)		Gross income (Rs. ha^{-1})	Net income (Rs. ha^{-1})	Benefit : Cost Ratio
	Y_1	Y_2	Y_1	Y_2	Y_1	Y_2	Y_1	Y_2	Y_1	Y_2	Pooled	Pooled	Pooled
T_1	**6.27**	7.12	**13.00**	14.23	**32.93**	33.35	**13.81**	13.87	**63.88**	63.92	12042.00	5393.00	1.81
T_2	**7.16**	7.98	**14.53**	15.42	**33.01**	34.10	**13.88**	13.92	**63.98**	64.01	13626.00	7487.00	2.22
T_3	**8.85**	9.42	**15.65**	16.25	**35.82**	35.81	**14.22**	14.27	**64.11**	64.12	16434.00	9385.00	2.33
T_4	**7.80**	8.08	**14.88**	16.15	**34.04**	34.88	**13.96**	13.99	**63.71**	63.85	14562.00	8563.00	2.42
T_5	**9.62**	10.49	**16.00**	17.06	**38.60**	39.13	**14.55**	14.61	**64.55**	64.59	18090.00	11491.00	2.74
T_6	**8.39**	8.97	**15.05**	16.05	**34.90**	35.22	**14.01**	14.09	**64.02**	64.05	15984.00	8675.00	2.19
T_7	**5.00**	5.25	**12.79**	13.00	**28.10**	28.76	**13.07**	13.55	**63.66**	63.75	9216.00	3937.00	1.74
S.E m (±)	**0.10**	**0.11**	**0.37**	**0.16**	**0.14**	**0.28**	**0.21**	**0.35**	**0.42**	**0.56**	-	-	-
C. D. (P = 0.05)	**0.31**	**0.34**	**1.13**	**0.50**	**0.44**	**0.87**	**0.72**	**1.15**	**1.55**	**1.75**	-	-	-

Y_1 = 2013 and Y_2 = 2014