RESEARCH PAPER

ADVANCE RESEARCH JOURNAL OF
C R P
IMPROVEMENT
Volume 6 | Issue 2 | December, 2015 | 144-150
e ISSN-2231-640X

DOI :
10.15740/HAS/ARJCI/6.2/144-150
Visit us: *www.researchjournal.co.in*

Production potential and economics feasibility of buckwheat (*Fagopyrum esculentum* Moench) as influenced by integrated weed management practices under Terai rgion of West Bengal

■ BINOY CHHETRI[1], S.B. SATPUTE, TAPAS DAS[1], D.T. SURJE[2] AND S.K. MAHATO[3]

AUTHORS' INFO

Associated Co-author :

[1]Department of Agronomy, Uttar Banga Krishi Viswavidyalaya, Pundibari, COOCHBEHAR (W.B.) INDIA

[2]Department of Genetics and Plant Breeding, Uttar Banga Krishi Viswavidyalaya, Pundibari, COOCHBEHAR (W.B.) INDIA

[3]Department of Pomology and Post Harvest Technology, Uttar Banga Krishi Viswavidyalaya, Pundibari, COOCHBEHAR (W.B.) INDIA

Author for correspondence:
S.B. SATPUTE
Department of Agronomy, Uttar Banga Krishi Viswavidyalaya, Pundibari, COOCHBEHAR (W.B.) INDIA
Email : sushil.satpute@yahoo.com

ABSTRACT : A field experiment was conducted during the winter season of 2011-2012 and 2012-2013 at the Instructional Farm of Uttar Banga Krishi Viswavidyalaya, Pundibari, Cooch Behar, and West Bengal. 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 lit. ha^{-1}(T_1), post-emergence of application of glyphosate @ 2.50 lit. ha^{-1} (T_2), pre-emergence application of fluchloralin @ 2.22 lit. 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 lit. ha^{-1}combined with post-emergence application of glyphosate @ 2.50 lit. ha^{-1} (T_6) and unwedded control (T_7). The economics of buckwheat under seven varying weed management practices showed that the hand weeding twice at 20 and 35 DAS recorded highest net income, benefit cost ratio and lowest cost of producing per kg of seed over other weed control practices, this is environmentally sound, socially acceptable and economically viable. Among the weed management practices pre-emergence application of fluchloralin @ 2.22 lit. ha^{-1} and post-emergence application of glyphosate @ 2.50 lit. ha^{-1} at 20 DAS produced higher yield attributes and yield over unwedded control whereas pre-emergence application of fluchloralin @ 2.22 lit. ha^{-1} followed by one hand weeding at 35 DAS produced seed yield comparable to hand weeding treatment.

KEY WORDS : Buckwheat, Yield, Herbicides, Economics

How to cite this paper : Chhetri, Binoy, Satpute, S.B., Das, Tapas, Surje, D.T. and Mahato, S.K. (2015). Production potential and economics feasibility of buckwheat (*Fagopyrum esculentum* Moench) as influenced by integrated weed management practices under Terai rgion of West Bengal. *Adv. Res. J. Crop Improv.,* **6** (2) : 144-150.

Paper History : Received : 07.02.2015; **Revised :** 08.10.2015; **Accepted :** 22.11.2015

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 Germany, Austria and other countries (Bernath, 2000). It has been used both in food formulation and as traditional medicine (Marshall and Pomeranz, 1982).

Cropping season in this region is limited as the vast

area (60-75%) remains fallow from November. Buckwheat is the only crop which can be taken successfully as a second crop after harvest of rice in the second fortnights of October to early part of November. This crop is getting momentum both in acreage and production because of short duration crop it fits well in the double cropping system of this zone but the farmers of this zone raise this crop without proper care of nutrient and suitable agronomic practices. The yield of buckwheat can be increased many fold if these factors are taken into consideration. Buckwheat is an important crop and is grown by the tribal during winter months in *terai* region of West Bengal with residual soil moisture in rice fallows.

Weeds are an important factor in the crop management; their presence causes stress in the crop production. 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 per cent, insects 30 per cent, diseases 20 per cent and other pests 5 per cent (Rao, 1983). The new agricultural production strategy involves the use of high yielding varieties of crops grown under heavy and costly inputs like fertilizer, irrigation and repeated measures of plant protection. These practices help in stimulating the growth of crops and weeds alike. If the weeds are not controlled in time, the purpose of adoption of the improved technology gets defeated. Large-scale weed control measures are possible at a very low cost through using chemicals and modern machinery for the purpose. 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). Weed management is also to be 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).

The renewed interest in buckwheat is based on its nutritional composition and feasibility for cultivation but buckwheat is susceptible to severe weed competition, especially at the early growth stage. Thus, herbicides application is an important component in the cultivation of this crop but due to the lack of knowledge about its chemical control, its cultivation is still restricted. The difficulty of buckwheat cultivation due to weed competition has also been reported by Sakaliene *et al.* (2000). Weeds pose a major threat to the productivity of buckwheat in the in northern part of West Bengal. To manage this problem, judicious and economic use of the herbicides could be an alternative to manual weeding, which is tedious and cumbersome.

RESEARCH PROCEDURE

The experiment was conducted at the Farm of Uttar Banga Krishi Viswavidyalaya, Pundibari, Cooch Behar, and West Bengal. 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 lit. ha^{-1} (T_1), post-emergence of application of glyphosate @ 2.50 lit. ha^{-1} (T_2), pre-emergence application of fluchloralin @ 2.22 lit. 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 lit. ha^{-1}combined with Post- emergence application of glyphosate @ 2.50 lit. ha^{-1} (T_6) and unweeded control (T_7). The results with the objective of studying the effects of different weed management practices on production potential and economics of buckwheat. Data on yield attributes characters like number of cymes $plant^{-1}$, number of seeds $cyme^{-1}$ test weight (g) (1000 seed weight), grain yield (t ha^{-1}), straw yield (t ha^{-1}) and harvest index (HI). Economic analysis is cost of cultivation (Rs. ha^{-1}), cost of treatment (Rs. ha^{-1}), total cost of cultivation (Rs. ha^{-1}), gross income (Rs. ha^{-1}), net income (Rs. ha^{-1}), benefit: cost ratio and cost of producing per kg of seed (Rs.)

Returns per rupee invested :

This is also called benefit: cost ratio or input - output ratio. This is obtained from the formula:

$$\text{Return per rupee invested} = \frac{\text{Gross returns}}{\text{Total (variable) cost of cultivation}}$$

In the same manner, return per rupee invested on a particular input can be computed. For example, return on labour can be calculated as follows:

$$\text{Return per rupee invested} = \frac{\text{Gross returns - (Cost of cultivation except that incurred on labour)}}{\text{Cost of labour}}$$

Return per rupee spent on chemicals and power can also be calculated likewise.

RESEARCH ANALYSIS AND REASONING

The findings of the present study as well as relevant discussion have been presented under following heads :

Yield attributes of buckwheat :

The effect of treatments was significant on yield attributes of buckwheat *i.e.* the number of cyme per plant at harvest, number of seeds per cyme and test weight (Fig. 1). The number of cymes per plant recorded lesser value during first year of the trial compared to that of the second year. Lesser number of cymes per plant was observed under unweeded control plot (T_7) during both the years of investigation due to 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 was recorded under hand weeding twice (T_5) followed by pre-emergence application of fluchloralin along with one hand weeding at 35 DAS (T_3), pre and post- emergence application of herbicides *i.e.* fluchloralin @ 2.22 lit. ha^{-1} and glyphosate @2.50 lit. ha^{-1}, respectively (T_6) and hoeing twice at 20 and 35 DAS (T_4) at all the stages of crop growth during both the years of investigation. This finding could be explained in the light of lesser weed- crop competition in these treatments which encouraged vegetative vigour and ultimately number of cymes per plant (Table 1). Number of seeds per cyme recorded the lowest value in unweeded control plot (T_7) during both the years of investigation

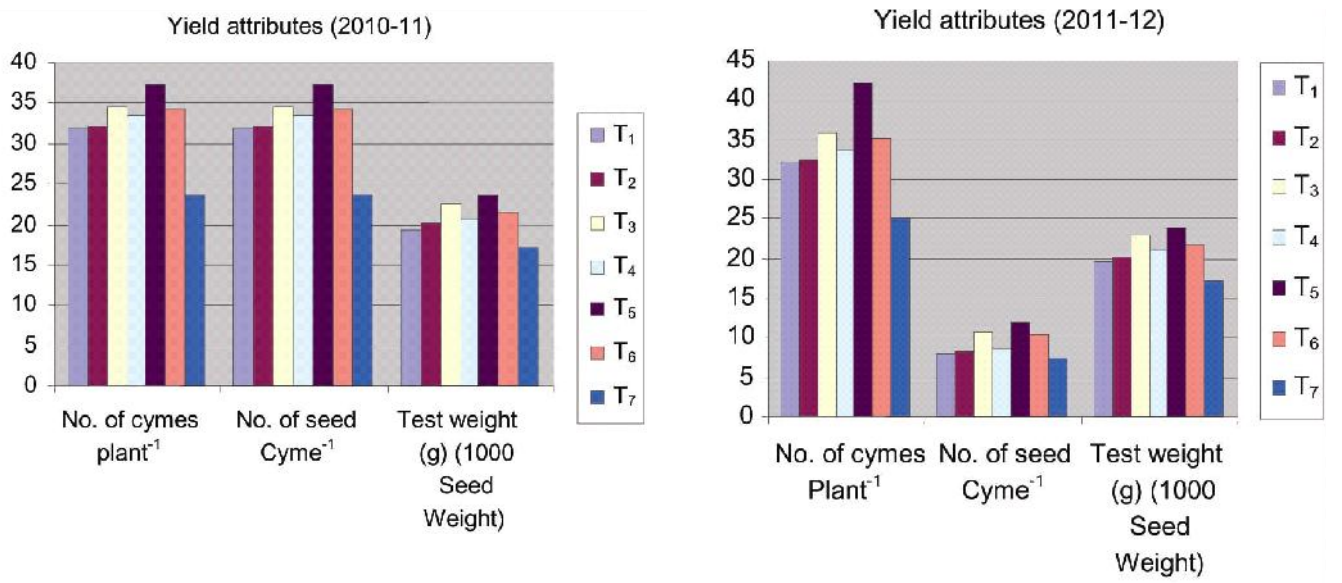

Fig. 1 : Effect of treatments of yield attributes of buckwheat

Table 1 : Effect of treatments of yield attributes of buckwheat

Treatments	No. of cymes plant^{-1}		No. of seeds cyme^{-1}		Test weight (g) (1000 seed weight)	
	Y_1	Y_2	Y_1	Y_2	Y_1	Y_2
T_1	31.88	32.15	7.67	7.99	19.29	19.53
T_2	32.09	32.38	8.00	8.33	20.05	20.32
T_3	34.66	35.96	10.60	10.66	22.64	22.91
T_4	33.34	33.66	8.33	8.67	20.77	20.97
T_5	37.20	42.38	11.33	12.00	23.65	23.81
T_6	34.39	35.11	9.67	10.33	21.44	21.85
T_7	23.55	25.19	7.00	7.33	17.04	17.08
S.E. (±)	1.77	0.60	0.42	0.44	0.34	0.29
C.D. (P = 0.05)	5.45	1.85	1.31	1.36	1.04	0.88

Y_1 = 2010-2011 and Y_2 = 2011-2012

(Table 1) due to 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 number of seeds per cyme was recorded under hand weeding twice at 20 and 35 DAS (T_5) followed by pre-emergence application of fluchloralin combined with one hand weeding at 35 DAS (T_3), pre and post-emergence application of herbicides (T_6) and hoeing twice at 20 and 35 DAs (T_4) during both the years of investigation (Table 1). Butachlor, one of the selective herbicides, failed to control weeds at one kg ha^{-1}. The seed yields of common buckwheat were positively correlated with straw yield and other yield contributing characters (numbers of seeds per plant, number of cymes per plant, plant density, test weight and plant height), but negatively correlated with weed biomass (Rana *et al.*, 2003). The findings were quite natural as weed- crop competition in T_5, T_3, T_6 and T_4 was much less from the initial stage of the crop growth to maturity compared to any other treatment tried in this investigation (Table 1). Lesser weed- crop competition through out 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.

Hand weeding twice (T_5) significantly recorded the highest test weight during both the years of investigation. Unweeded control 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). The yield

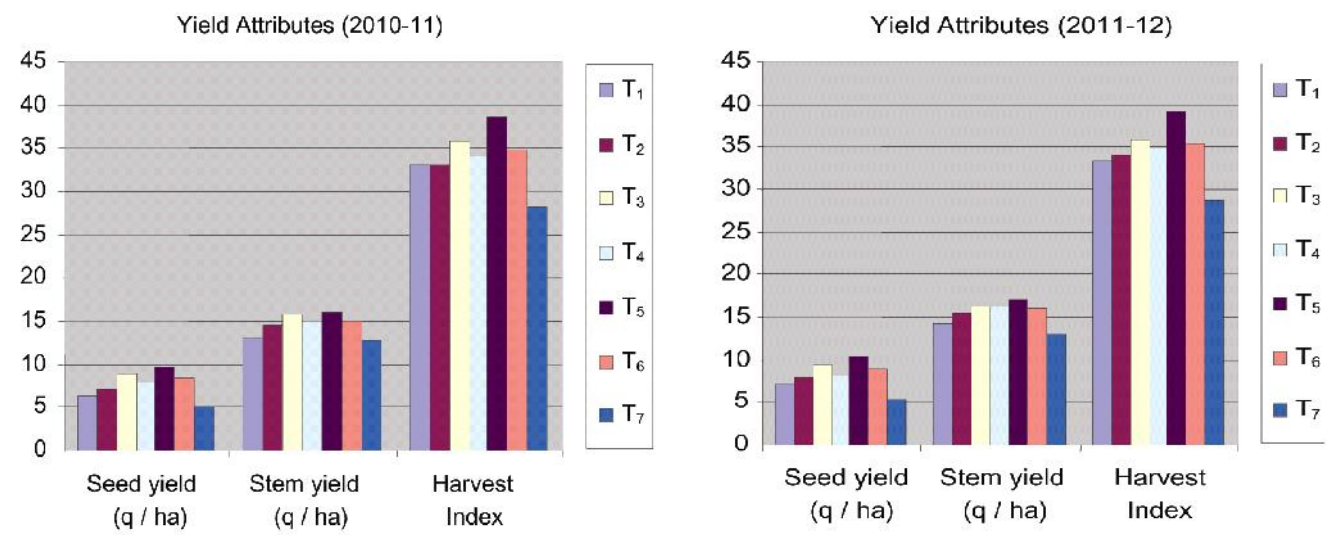

Fig. 2 : Effect of treatments on seed yield, stem yield and harvest index of buckwheat

Table 2 : Effect of treatments on seed yield, stem yield and harvest index of buckwheat

Treatments	Seed yield (q ha^{-1})		Stem yield (q ha^{-1})		Harvest index	
	Y_1	Y_2	Y_1	Y_2	Y_1	Y_2
T_1	6.27	7.12	13.00	14.23	32.93	33.35
T_2	7.16	7.98	14.53	15.42	33.01	34.10
T_3	8.85	9.42	15.65	16.25	35.82	35.81
T_4	7.80	8.08	14.88	16.15	34.04	34.88
T_5	9.62	10.49	16.00	17.06	38.60	39.13
T_6	8.39	8.97	15.05	16.05	34.90	35.22
T_7	5.00	5.25	12.79	13.00	28.10	28.76
S.E. (±)	0.10	0.11	0.37	0.16	0.14	0.28
C.D. (P = 0.05)	0.31	0.34	1.13	0.50	0.44	0.87

Y_1 = 2010-2011 and Y_2 = 2011-2012

of buckwheat recorded lesser quantity of seed per hectare in first year of trial compared to that of the second year of experimentation. Considering the overall effect on treatment, it would further be seen from the said table that 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 climatic condition during the cropping period. 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 led to higher production of buckwheat seed in the second year.

The lowest seed yield of buckwheat was recorded under unweeded control (T_7) during both the years of experimentation (Fig. 2). This was due to heavy infestation and rank growth of weeds in unweeded control. The improve method of cultivation such as good tilth of the soil, application of manure and fertilizer provided a highly congenial environment for rank growth of weeds. This was ultimately reflected on the yield of the crop (Table 2). The highest seed yield was recorded under hand weeding (twice) (T_5) in both the years of investigation, this was closely followed by pre-emergence application of fluchloralin combined with hand weeding at 35 DAS (T_3) and pre-emergence application of fluchloralin alone with post-emergence application of glyphosate at 20 DAS (T_6). This was due to the fact that these three treatments were quite effective throughout the period of crop growth in controlling weed infestation in buckwheat field. Yield attributing characters like number of cymes per plant, number of seeds per cyme and test weight (Table 1) were quite high in these treatments. Cumulative effect of all these has been reflected on the seed yield of the crop. Post-emergence application of glyphosate when applied at 20 DAS (T_2) produced high seed yield than pre-emergence application of fluchloralin (T_1). Hoeing twice at 20 and 35 DAS (T_4) recorded higher seed yield than the herbicidal treatment when applied alone (T_1 and T_2). Garbar and Bulavin (2003) reported that the late periods of ploughing increased weed infestation in buckwheat and decreased its yield. Herbicides application eliminates the negative influence of ploughing.

Stem yield of buckwheat was influenced by the different weed control practices. The maximum stem yield was obtained under hand weeding twice (T_5) followed by pre-emergence application of fluchloralin along with one hand weeding (T_3) and pre-emergence and post-emergence application of fluchloralin and glyphosate, respectively (T_6) and hoeing twice (T_4). Pre-emergence application of fluchloralin (T_1) and post-emergence application of glyphosate when applied alone gave higher stem yield over unweeded control. The lowest value of stem yield was recorded under unweeded control (T_7). Kavoliunaite and Salna (2003) reported that the pre-emergence application of chloridazon (1.5-2.5 lit. ha^{-1}) increased grain yield and straw yield by 10.5-12.5 per cent such an increase was significantly compared with the control, but not with the other levels. Chloridozon at 1.5 lit. ha^{-1} was most effective for weed control in buckwheat

The highest value of HI was noted when hand weeding was done at 20 and 35 DAS (T_5) followed by pre-emergence application of fluchloralin @ 2.22 lit. ha^{-1} along with one hand weeding at 35 DAS (T_3), pre + post-emergence application of fluchloralin + glyphosate, respectively (T_6) and hoeing twice at 20 and 35 DAS (T_4). Pre-emergence application of fluchloralin (T_1) and post-emergence application of glyphosate (T_2) significantly recorded highest HI over control. The lowest HI was recorded under unweeded control.

Economics of buckwheat :

Different weed control practices influenced the gross income (Table 3 and Fig. 3), the highest gross income was under hand weeding twice (T_5) followed by pre-emergence application of fluchloralin along with one hand weeding (T_3) and pre-emergence and post-emergence application of fluchloralin and glyphosate, respectively (T_6). The lowest 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. 11491) 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) due to 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. Kavoliunaite and Salna (2003) also opined that the spray of betanal AM at 1.5-3.0 lit. ha^{-1} resulted in a significantly

Table 3 : Economics of buckwheat cultivation as influenced by different treatments

Treatments	Cost of cultivation (Rs. ha^{-1})	Cost of treatment (Rs. ha^{-1})	Total cost of cultivation (Rs. ha^{-1})	Gross income (Rs. ha^{-1})	Net income (Rs. ha^{-1})	Benefit : cost ratio	Cost of producing per kg of seed (Rs.)
T_1	5280.00	1170.00	6649.00	12042.00	5393.00	1.81	9.94
T_2	5280.00	860.00	6139.00	13626.00	7487.00	2.22	8.11
T_3	5280.00	1770.00	7049.00	16434.00	9385.00	2.33	7.72
T_4	5280.00	720.00	5999.00	14562.00	8563.00	2.42	7.42
T_5	5280.00	1320.00	6599.00	18090.00	11491.00	2.74	6.57
T_6	5280.00	2030.00	7309.00	15984.00	8675.00	2.19	8.23
T_7	5280.00	-	5280.00	9216.00	3937.00	1.74	10.31

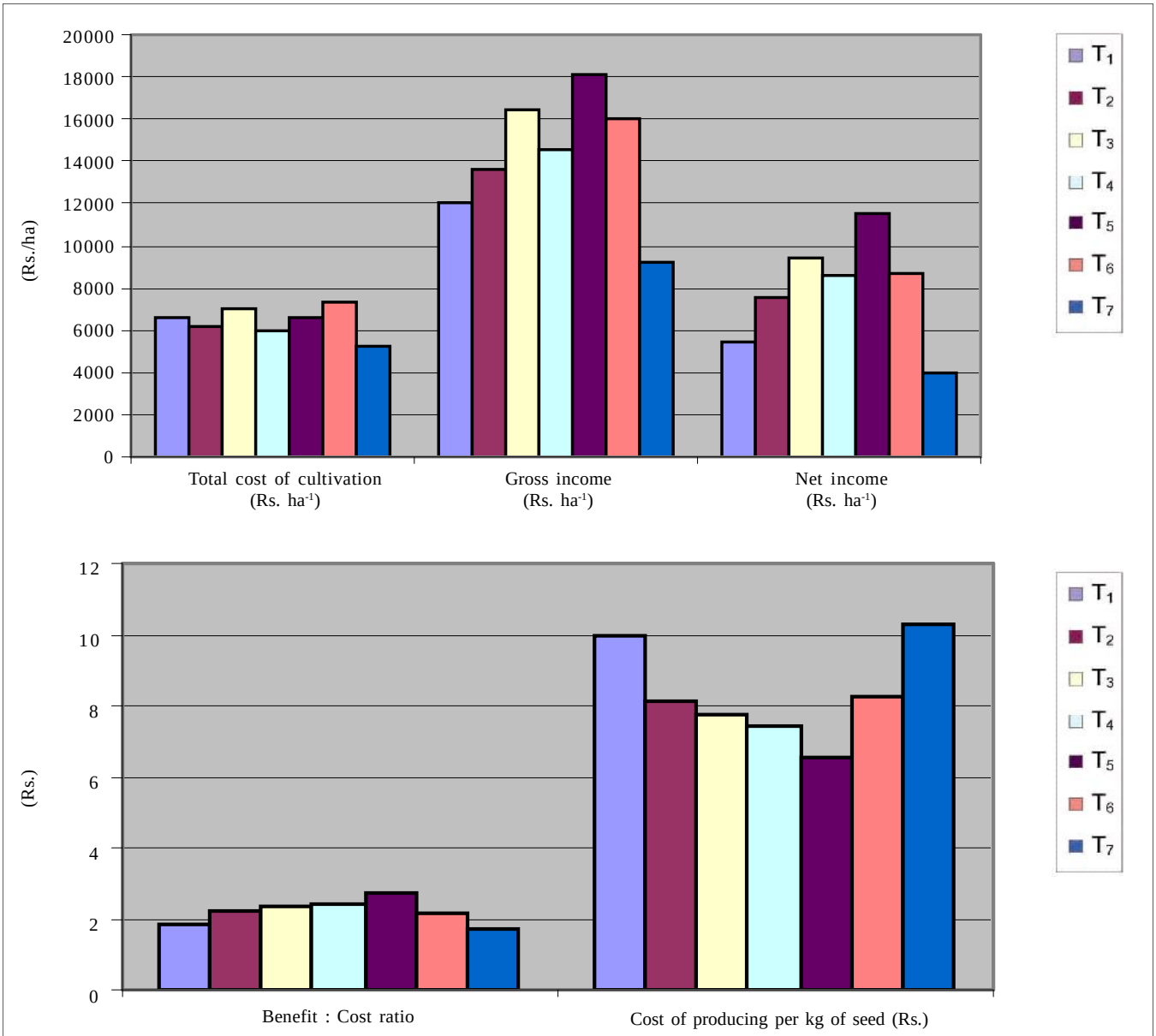

Fig. 3 : Economics of buckwheat cultivation as influenced by different treatments

increase the grain yield (12.3-14.5%) however; it was economically cost effective to spray only 1.5-2.0 lit. ha^{-1}. This is due to the low cost of treatment occurred during hoeing operation. Minimum cost of producing per kg of seed (Rs. 6.57) was recorded under hand weeding twice (T_5) due to maximum seed yield among the different weed control practices.

LITERATURE CITED

Altieri, M.A. and Letourneau, D.K. (1982). Vegetation management and biological control in Agro-ecosystem: ecological approaches. pp. 1-6.

Bernáth, J. (2000). *Medicinal and aromatic plants* (in Hungarian) *Mezo. Publ*. Budapest.

Garbar, G.L. and Bulavin, L.A. (2003). Influence of ploughing time and herbicides on buckwheat yield. *Zashichita-Rastenii*., **27** : 75-78.

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.

Kavoliunaite, I. and Salna, A. (2003). The respons of buckwheat and weeds to dose rates of betanal AM. Zemdirbyste, Mokslo-Darba., **82**: 126-136.

Marshall, H.G. and Pomeranz, Y. (1982). Buckwheat: Description, breeding, production and, utilization. pp. 157-210 In : *Advances in cereal science and technology*. Vol. 5. (Y. Pomeranz, ed.). American Associationof Cereal Chemists Incorporated, St. Paul, Minnesota.

Rana, S.S., Mondal, K.K., Sood, Pakaj and Pal, Rajinder (2003). A preliminary study on the herbicidal weed control in buckwheat. *Fagopyrum*, **20** : 81-84.

Rao, V.S. (1983). *Principles of weeds science*. Oxford and IBH Publishing Co., New Delhi. pp. 23-42.

Sakaliene, O., Salna, A., Metspalu, L. and Mitt, S. (2000). Evaluation of the bioefficacy of herbicides in buckwheat crop. *Trans. Estonian Agric. Univ., Agron.*, **209** :175-177.

Shaw, W.C. (1982). Integrated weed management systems technology for pest management. *Weed Sci. Suppl*., **30** : 2-12.