



## Research paper

# Efficiency and Economic Feasibility of Manual and Chemical Weed Control in Faba Bean

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## ABSTRACT

The performance of hand weeding was compared with that of a tank mix of herbicides imazythapyr (Pursuit) and pendimethalin (Stomp) applied as pre-emergence treatment for weeds control in faba bean (*Vicia faba*) in the River Nile State for two successive seasons (2005/06-2006/07). Hand weeding was undertaken once at 4 weeks after sowing and twice at 4 and 6 weeks after sowing. Pursuit in tank mix with Stomp was applied at the recommended rate. There was a variation in efficiency of hand weeding and herbicides application, the mean of the total weeding efficiency of hand weeding at 4 and 4+6 weeks after sowing and pre-emergence herbicides was 75.4, 78.6 and 87.1%, respectively. The yield of the treated plots out yield the weedy plot. The net benefit from hand weeding was less than from using herbicides.

**Keywords:** *Herbicides, faba bean, weed control*

## الكفاءة والجدوى الاقتصادية لمكافحة الحشائش يدوياً وكيميائياً في الفول المصرى

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تمت هذه الدراسة لمقارنة مكافحة الحشائش يدوياً وباستخدام مبيدات قبل النمو (بيرسوت+أستمب) في الفول المصري بولاية نهر النيل خلال موسمين متتاليين (06/2005-05/2004). تم إجراء المكافحة يدوياً مرة بعد اربعة اسابيع ومرتان بعد أربعة وستة أسابيع من الريه الاولى، أما مبيدات ما قبل الزراعة فقد تم خلطها في الرشاشه حسب الجرعة الموصى بها ورشها قبل الريه الاولى. أظهرت النتائج المتحصل عليها أن هناك تباين فى كفاءة المكافحة اليدوية والمبيدات، حيث كان متوسط الكفاءة خلال الموسمين للمكافحة يدوياً بعد 4 اسابيع و4+6 أسابيع واستعمال المبيدات هي 75.4، 78.6 و 87.1 % على التوالي. وأعطت الاحواض التى تمت بها المكافحة إنتاجية أعلى من التي تركت دون مكافحة الحشائش. من الناحية الاقتصادية كان العائد من المكافحة اليدوية أقل خلال الموسمين.

## **Introduction**

Agriculture represents the main occupation in Sudan. More than 80 % of the population is engaged in agricultural production. Contribution of agriculture to the national economy is estimated to be 40 %. In the River Nile State, irrigated agriculture extends along the River Nile banks. Farm holdings range between 0.5-2 ha. The main field crops grown in winter season are the legume crops and wheat. Faba bean (*Vicia faba*) is one of the main state's cash crops and occupies an area of 20000 to 35000 ha (Mohamed *et al.*, 2014). Average faba bean yield is about 1.8t/ha. Weeds compete with the crop for water, nutrients, light and space. Weeds differ in the damage that they cause to crops and this is governed by their growth habit, vigor, seed production, regenerative capacities and time of germination. Since the beginnings of agriculture, growers have had to compete with weeds for crop products grown for human use and consumption. The total global potential loss due to weeds infestation accounts for 45% (Mohamed *et al.*, 2014), thus weed control is indispensable in every crop production system.

The faba bean crop is very sensitive to competition from both broad-leaved and grassy weeds (Wilson and Cussan, 1970, 1972; Glasgow *et al.*, 1976; Lawson and Wiseman, 1978 and Brink and Belay, 2006). Annual weeds are considered to be one of the limiting factors to faba bean growth and yield (Kukula *et al.*, 1983). The extent to which crop yield is reduced by weeds depends not only on crop, the environment and on the weed species and density, but also on the period for which weeds are allowed to compete

freely with the crop (Dawson, 1970). The critical period at which there is a severe competition of weeds with the crop is in the range of 4 to 6 weeks from the sowing date (Mohamed, 1996 and Kavurmaci *et al.*, 2010), therefore, good weed control is an essential part of the successful cultivation (Hebblethwaite, 1983).

Hand weeding is common around the world, and it is estimated that 50-70% of the world's farmers control weeds with this method (Hill, 1982 and Wicks *et al.*, 1995). Farmers rely on family members especially women and children for weeding and often use weeds for animal feeding or even as human food. Commercial farmers with larger land holdings use more hired labor. The oldest form of weeding is the removal and pulling by hand, gradually, techniques have been improved with the use of implements adapted to do this job, using array of hand tools developed for local conditions; crops and weed present. Manual weeding by casual labor have been used for weed control in different crops in Sudan, however, hand weeding is still the most common method practiced by the farmers, and represents 85% of the practices in usage for weed control in the northern Sudan, while chemical represents only 6% (Hashim and Abdalla, 2005).

During the past four decades, large number of herbicides has been introduced as weed killers in many countries of the world. However, this change benefited mainly the industrialized countries, where agriculture was already highly mechanized and the level and value of output were able to bear the cost of these products. In developing countries, many reasons faltering the progress to use these chemicals, from which, small farmers

have no access to the necessary equipment; herbicides are relatively expensive products; prices paid to farmers produces are still low; fear of adoption of herbicides will tend to exacerbate unemployment and the danger of wrong dose-rates to some plant products especially in illiterate societies.

Mohamed (1996) indicated that unrestricted weed growth and delayed weeding reduced faba bean yield by 80%. Several experiments were undertaken on efficiency and economic feasibility of chemical weed control in faba bean in northern Sudan. The herbicides imazythapyr and its tank-mixers with pendimethalin or oxyfluoren were recommended for controlling weed (Mohamed *et al.*, 2004).

The present investigation was undertaken to compare performance of efficiency and economic feasibility of hand weeding and imazethapyr/pendimethalin tank for weeds in faba bean in the River Nile State.

### **Materials and Methods**

The performance of the hand weeding using a hoes with 9 cm cutting width and 65 cm wood handle was compared with that of a combination of imazythapyr at 0.05 kg a.i.ha<sup>-1</sup>, pendimethalin at 1.2 kg a.i.ha<sup>-1</sup>, applied after planting and before first irrigation in faba bean (*Vicia faba*) in the River Nile State for two successive seasons (2005/06-2006/07). Hand weeding (HW) was carried out at 4 weeks and a 4+6 weeks after first irrigation.

The plot size for each treatment was 2.4x7m. A randomized complete block design with four replications was used. A quadrant of 60x60cm was placed between ridges before and after weeding the plots by hand weeding,

and on weedy and herbicides treated plots to count the weeds to assess weeding efficiency. Weed control was assessed as a percentage of total weeds at 6 weeks after sowing on weedy plots to the removed or killed weeds after weeding operation for each treatment. Crop samples of 2 ridges by 2 m long were cut; manually threshed and cleaned to assess yield. At harvest of each plot, at the same time a weed sample from 1m<sup>2</sup> area for each plot under the experiment was collected and dried on direct sun for one week, then weighed.

Economic analysis was performed using MSTAT-C computer program to assess the costs of the weeding methods under test. Hand weeding cost was calculated according to the work rate of a 6 hours workday and 10 SDG/day labour wage, work rate was calculated from the time consumed to apply each treatment to every plot with measured area, while the herbicide cost including the chemicals price of 59.5 and 95.2 SDG ha<sup>-1</sup> for imazythapyr and pendimethalin, respectively, and 35.7 SDG ha<sup>-1</sup> for the labour for spraying. Yield selling of 1.2 SDG kg<sup>-1</sup> was the market price after harvest.

## **Results and Discussion**

From weed counting on all plots, there was no variation in the treated and weedy plots concerning weed/m<sup>2</sup>, with about 144 and 140 in treated and weedy plot, respectively in the first season and 131 and 130 in second season of the experiment, taking into account a fair ground to treatments, with the dominant species *Beta vulgaris*, *Sinapis arvensis*, *Portulaca oleracea*, *Sorghum sudanensis* (wild sorghum), where grasses represent

57%. There were variations among hand weeding at 4WAS, 4+6WAS and herbicides application in the weeding efficiency. Mean of the two seasons to control grasses and broad-leaved weeds at 4 weeks after sowing by toryia was 88.1, 70%, respectively, where at 4+6 weeks after sowing was 83.2, 74.5%, respectively, and for imazythapyr and pendimethalin was 92, 85%, respectively. The mean of the total efficiency of hand weeding at 4, 4+6 weeks after sowing and herbicides was 75.5, 78.8 and 88.6%, respectively (Table1).

Table (2) shows the mean of yield of the hand weeding and herbicides compared to weedy plot. Comparison of means ranked the yield of herbicides and 4+6 WAS hand weeding first, 4WAS hand weeding second, and weedy in the last. Economic analysis showed that the net benefit from hand weeding in the two seasons was less than using herbicides (Table 3). Marginal analysis revealed just how the net benefit from every treatment increases as the amount of cost increases, where any treatments fall below the curve was not feasible, as shown in Fig.1 and 2.

A study on faba been by Mohamed *et al.* (2004), assessing the same two herbicides with the same doses through three consecutive seasons, obtained an average efficiency of 82.5% for three years which is nearly the same as in this study. The effectiveness of herbicides depends on soil type and in the weed flora, thus far, there is a wide variation in these two factors in River Nile State.

## **Conclusion**

The recommended herbicides for faba bean is pre-emergence, farmers behavior to control weeds after their presence, and the manual weeding is done normally by farm owner or volunteer for animals feed, when consider these the hand weeding it may become feasible, and still represent one of practices for weed control in faba bean in River Nile State.



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**Table 1: Efficiency of manual and chemical weed control in faba bean in the River Nile State**

Season  Treatment	2005-06					2006-07					Mean weed Control (%)		
	Grass/m <sup>2</sup>	Brd.L/m <sup>2</sup>	Weed control (%)			Grass/m <sup>2</sup>	Brd.L/m <sup>2</sup>	Weed control (%)			Grass	Brd.L	Total
			Grass	Brd.L	Mean			Grass	Brd.L	Mean			
4WAS HW	63	87	85	76	81	97	37	77	64	70	81	70	75
4+6WAS HW	68	73	89	76	83	89	34	77	73	75	83	74	79
Pursuit+Stomp	80	61	87	92	89	96	41	98	78	88	92	85	89
Weedy	65	75				92	38						
SE	4.2 ns	5.6 ns	1.1 ns	1.5**	1.1**	3.4ns	2.7ns	1.5**	1.5**	0.75**			
C.V. (%)	15.1	13.3	2.6	3.7	2.6	7.3	14.2	3.5	4.1	1.9			

WAS = weeks after sowing

HW= hand weeding

Brd.L= broad leaved

\*and\*\* = indicate significant at 5% and 1% level, respectively.

**Table 2: Effects of control method on weeds number and dry weight and faba bean yield in the River Nile state**

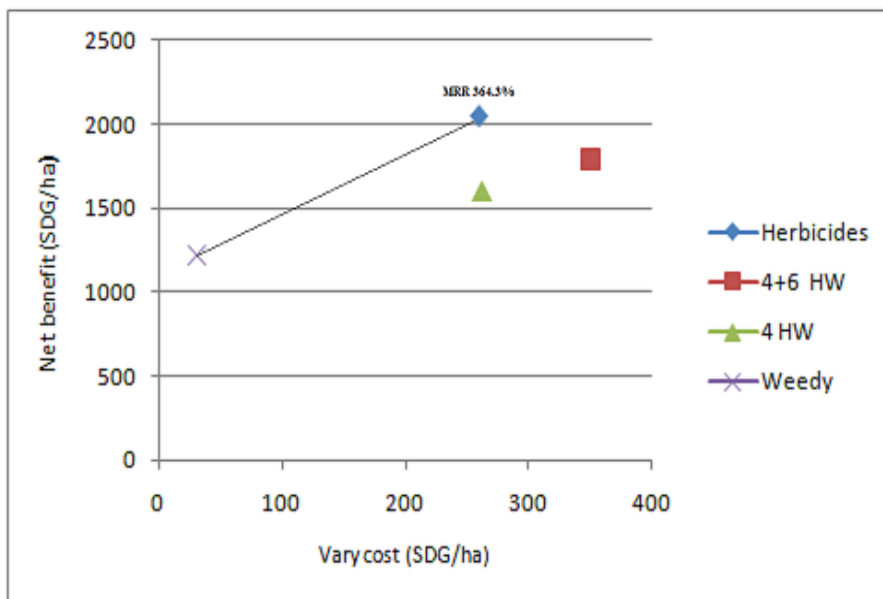
Season	2005-06				2006-07			
	Plants/m <sup>2</sup>	Weeds/m <sup>2</sup>	Wdwt (g/m <sup>2</sup> )	Yield (kg/ha)	Plants/m <sup>2</sup>	Weeds/m <sup>2</sup>	Biomass (kg/ha)	Yield (kg/ha)
<b>4WAS HW</b>	30	150	190.3	1550 <sup>c</sup>	28	134	10832	5046 <sup>b</sup>
<b>4+6WAS HW</b>	28	141	195.8	1783 <sup>b</sup>	26	123	12083	6008 <sup>a</sup>
<b>Pre- m.herbicides</b>	28	141	150.0	1924 <sup>a</sup>	20	137	12083	6056 <sup>a</sup>
<b>Weedy</b>	26	140	280.5	1041 <sup>d</sup>	27	135	10872	4341 <sup>c</sup>

WAS= weeks after sowing      HW= hand weeding      Wdwt= weeds dry weight  
 Means in the same column with the same letters are not significantly different at 5% level

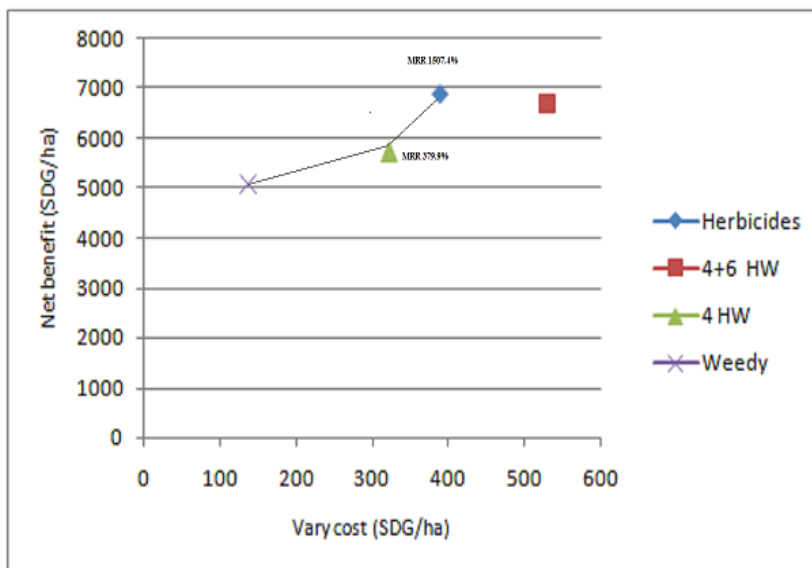
**Table 3: Marginal analysis for the hand weeding compared to herbicides treatment**

<b>Treatment</b>	<b>Value of output (SDG/ha)</b>	<b>Weeding cost (SDG/ha)</b>	<b>Threshing cost (SDG/ha)</b>	<b>Net benefit (SDG/ha)</b>	<b>MNB<sup>†</sup> (SDG/ha)</b>	<b>MRR<sup>ψ</sup> (%)</b>
<b>2005-06</b>						
<b>Herbicides</b>	2308.8	204.7	54.6	2049.5	831.4	364.3*
<b>4+6 HW</b>	2139.6	296.5	53.5	1789.6		
<b>4 HW</b>	1860	213.8	47.9	1598.3		
<b>Weedy</b>	1249	0	31.1	1218	0.0	0.0
<b>2006-07</b>						
<b>Herbicides</b>	7267.2	204.7	183.5	6879.0	1136.6	1507.4*
<b>4+6 HW</b>	7209.6	348.0	180.2	6681.4		
<b>4 HW</b>	6055.2	155.0	166.8	5733.4	669.7	379.9*
<b>Weedy</b>	5209.2	0	136.5	5072.7	0.0	0.0

† Marginal net benefit    \* marginal variable cost    ψ marginal rate of return    ♦ index of variability



**Fig. 1. Net benefit of using hand weeding and herbicides control for season 2005-06**



**Fig. 2: Net benefit of using hand weeding and herbicides control for season 2006-07**

