Journal of Research in Ecology

An International Scientific Research Journal

ISSN No: Print: 2319 –1546; Online: 2319– 1554

**Original Research**

# Evaluation of the effect of some herbicides on *Vicia faba* L. growth traits

**Authors:**
**Hashim Haneen Kareem Aldhahi[1], Hussien I Almtarfi[2] and Ali J Al-Sarraji[2]**

**Institution:**
1. Plant Protection Department, College of Agriculture, University of Misan, Iraq.

2. Soil Sciences and Water Resources Depatment, College of Agriculture, University of Wasit, Iraq.

**Corresponding author:**
**Hashim Haneen Kareem Aldhahi**

**ABSTRACT:**

A field experiment was conducted to estimate the effects of registered and unregistered herbicides in some broad bean (*Vicia faba* L.) growth traits. Four herbicides were used in this study: Illoxan (Diclofop - methyl) with two rates 0.88 and 1.76 kg a.i./ha, Basagran (bentazone) at 1.44 kg a.i./ha, Treflan (trifluralin) at 0.576 kg a.i./ha and TOPIK 15 wp (clodinafop-propargyl) at 0.12 kg a.i./ha as well as the control treatment (non-treated). Most of these herbicides showed a reduction of most of the parameters. Control treatment recorded a significant superior in leaf area, root size and top biomass weight which was 341 cm², 5.90 cm² and 2.46 gm respectively, while; TOPIK recorded the higher number of leaves (20.67) without significant differences as compared with control treatment. All herbicides revealed no differences between them in most parameters except Illoxan at 0.88 kg a.i./ha, which gave the best results in most plant growth traits while trifluralin gave higher degree of injury (2.33).

**Keywords:**

Herbicides, Degree of injury, Growth traits, Broadbean.

**Article Citation:**
**Hashim Haneen Kareem Aldhahi, Hussien I Almtarfi and Ali J Al-Sarraji**
Evaluation of the effect of some herbicides on *Vicia faba* L. growth traits
**Journal of Research in Ecology (2018) 6(2): 1808-1813**

**Dates:**
**Received:** 05 June 2018 **Accepted:** 30 June 2018 **Published:** 31 July 2018



**Web Address:**
http://ecologyresearch.info/documents/EC0582.pdf



Journal of Research in Ecology

## INTRODUCTION

Broadbean (*Vicia faba* L.) is the most important legume grain in Iraq, with high source of protein and as a rotation crop ameliorating soil fertility. Despite the importance of the crop in the traditional farming systems, the yield is generally low due to several factors, including poor soil fertility, inadequate plant nutrition, sub-optimal weed control and the lack of improved varieties (Agegnehu *et al*., 2005) (Al-Aidi *et al*., 2014). Broadbean *(Vicia faba* L.) is a rich of nutrients and is used for human diets, higher feed value than other legumes. In addition, broadbean can be used to feed livestock. It has 25% protein and higher in energy than soybean. Also, it can be used to replace soybean for protein supplementation. The bean makes high quality silage. It is swathed when lower pods begin to blacken. Moreover, the beans is poor competitors for weeds. Herbicides that are normally used to control weeds in beans are similar to pea herbicides (Machado *et al*., 2006). Worldwide, weeds constitute a major constraint to the production of legumes as many legume species are poor competitors to the weeds because of slow growth rate and limited leaf area development at the early stages of crop growth while, when optimum weed control is not achieved, losses could be substantial (Solh and Pala, 1990). The loss due to weeds competition could vary from site to another or from season to season depending on the species of legume and soil type. Weeds can reduce crop yields more than 50% through competition for moisture (Dyck and Liebman, 1994).

One of the major environmental concerns today is using pesticides. Though indiscriminate use of different group of herbicide chemicals as pesticides have become a necessity but on frequent use they could cause undesirable secondary consequences on higher plants. A possible source of genetic damage leading to instability may be due to regular application of herbicides to crop plants (Adam *et al*., 1990) Some researchers have reported a relationship between changes in the cell division activities of nucleic acids and proteins, because of the misbalance of pesticides The synthesis of important macro molecules alter the hereditary constitution of plants, transmitting damaged, genetic materials to the subsequent generation (Al-Ahmadi, 2013). A variety of toxic chemicals are used in the agriculture for the protection of crops against damages caused by pests, weeds, fungi, and etc., the agro-chemicals are known to affect the physiological and metabolic processes in various plants and other organisms through clastogenic and turbo genic mutations in cells leading to deleterious genetic effects (Al-Chalabi, 1988).

Many studies showed that herbicide causes differing physiological processes in plants including respiration, photosynthesis and protein synthesis (Moreland, 1967). Otherwise, many literatures it is noticed that the use of chemical pesticide for controlling plant pests in the modern agriculture causes deleterious effects on hereditary materials in both mitotic and meiotic cell division and cause genetic damage to man, domestic animals and economical plants (Ghareeb, 1998). In addition, herbicides applied to leguminous crops constitute a potential hazard to the establishment and performance of the nitrogen fixing root nodules.

It has been reported that foliar application of the herbicides bentazone and MCPA (2-methyl-4-chlorophenoxyacetic acid) to many leguminous crops at the recommended rates altered the morphology of root hairs and reduced nodule numbers and nitrogen activity (Ljunggren and Martensson, 1980). The present study was conducted to estimate the effects of registered and unregistered herbicides in broad bean (*Vicia faba* L.) growth traits.

## MATERIALS AND METHODS

Field studies were conducted at the agriculture college at Wasit University, Iraq, in the year 2017. Herbicide characteristics and their applied rates in the soil type at the site of study are given in Tables 1 and 2.

**Table 1. Type, rate and time of the studied herbicide treatments**

| S. No | Treatment | Herbicide trade name | Common name | Rate of application of herbicides (kg a.i./ha) | Time application of herbicides | Weeds type |
|---|---|---|---|---|---|---|
| 1 | $T_1$ (control) | - | - | - | - | - |
| 2 | $T_2$ | Basgran | Bentazone | 1.44 | After 18 days from planting | Broad weeds |
| 3 | $T_3$ | Traflan | Trifluralin | 0.57 | After 18 days from planting | Broad and some grass weeds |
| 4 | $T_4$ | Topic | Clodinafop-propargyl | 0.12 | After 18 days from planting | Broad weeds |
| 5 | $T_5$ | Illoxan | Diclophop-methyl | 0.88 | After 18 days from planting | Grass weeds |
| 6 | $T_6$ | Illoxan | Diclophop-methyl | 1.76 | After 18 days from planting | Grass weeds |

The treatments were arranged as a randomized completely design with three replicates. Each plot was in 10 cm diameter and have the same soil amount type.

Domestic broad beans were planted at October 15, 2010. The herbicide treatments were applied on 18 days after sowing. The treatments include six applied rate of herbicides. Their rates were Basagran (bentazone) in 1.44 kg a.i./ha, TOPIK (clodinafop-propargyl) in 0.12 kg a.i./ha, Treflan (trifluralin) in 0.57 kg a.i./ha, Illoxan (diclofop-methyl) in 0.88 and 1.76 kg a.i./ha and control without any treatment. The herbicides were sprayed on the foliar parts of the *Vicia faba* until the wet by using hand sprayer and the planted plots were irrigated as per the plant need until the plants reach flowering stage. The growth habit, leaf area index, plant height, branching, root size and others traits were calculated and collected from the field using the visual evaluations of broad bean. Each plant was visually rated for herbicide injury (injury rating) on a scale of 0 to 5 (0= no injury and 5= dead plant) (Al-Chalabi, 1988).

**Statistical analysis**

Statistical analyses were carried out using randomized complete design by using PROC GLM (SAS version 9.3, SAS Institute Inc., Cary, NC, USA) following the analysis of variance (ANOVA) procedure. Data were tested by ANOVA and F statistics (F-value) and probability statistics (P-value) are presented. LSD and means were separated at $p \leq 0.05$ levels (Stell and Torrie, 1960)

## RESULTS AND DISCUSSION

**Degree of visual injury**

The Table 3 shows the degree of injury of herbicide rates in the broad bean plants. After treating with trifluralin (0.57 kg a.i./ha) and diclofop-methyl (1.76 kg a.i./ha), the plant showed symptoms of chlorosis, burning, blackening of leaves and the rotation of upper leaves. This means that the five degree scale of this result agree with the reports (Al-Chalabi, 1988), who showed that the trifluralin at higher rate causes inhabitation on protein formation and restrict electron chain transformation. This result is also in agreement with (Alagawadi and Reddy, 1986) as they found harmful effect of trifluralin in groundnut treated with 250-500 ppm. However, the symptoms of the irreparable damage that occurred, could impact the quantity or quality of

**Table 2. Chemical and physical properties of soil**

| S. No | Parameters | | Results |
|---|---|---|---|
| 1 | pH | | 7.2±0.157 |
| 2 | EC (ds/m) | | 1.9±0.290 |
| 3 | Soil Texture | | Sandy loam |
| 4 | Soil fractions (g/kg) | Sand | 700 |
| | | Loam | 199 |
| | | Clay | 100 |
| 5 | Organic matter (g/kg) | | 14±0.433 |

**Table 3. Effects of the studied herbicides on some properties of the growth traits**

| S. No | Treatment (herbicides) applied | Leaf area ($cm^2$) | Leaves (No./plant) | Roots size ($cm^3$) | Plant height (cm) | No. of branches |
|---|---|---|---|---|---|---|
| 1 | $T_1$ (Control ) | 341±122.51$^{a}$ | 22.33±5.03$^{a}$ | 5.90±1.85$^{a}$ | 22.00±1$^{a}$ | 6.0±1.66$^{a}$ |
| 2 | $T_2$ (Bentazone) | 158±40.41$^{bc}$ | 15.67±3.51$^{b}$ | 2.00±0.5$^{bc}$ | 15.65±4.93$^{abc}$ | 5.1±0.82$^{b}$ |
| 3 | $T_3$ (Trifluralin) | 63±23.56$^{c}$ | 15.67±1.15$^{b}$ | 1.00±0$^{b}$ | 10.67±1.15$^{c}$ | 3.0±0.57$^{c}$ |
| 4 | $T_4$ (Clodinafop-propargyl) | 118±20.83$^{bc}$ | 19.33±1$^{ab}$ | 2.00±0$^{bc}$ | 13.00±1$^{bc}$ | 4.3±0.33$^{b}$ |
| 5 | $T_5$ (Diclofop-methyl) | 171±30.29$^{b}$ | 20.67±1.52$^{ab}$ | 3.67±0.57$^{c}$ | 19.33±0.57 $^{ab}$ | 4.6±1$^{b}$ |
| 6 | $T_6$ (Diclofop-methyl) | 169±38.76$^{b}$ | 17.00±3.78$^{ab}$ | 2.50±1.5$^{bc}$ | 14.67±6.65 $^{bc}$ | 5.0±1.06$^{b}$ |

*Similar litters indicate non significant differences between the trait means; *Different litters indicate significant differences.

yields that might be suppressed or diminished or with slowing or damaging of growth of plants as a result of the herbicide causing damage (Barker and Pilbeam, 2015).

**Total dry biomass and number of leaves (leaves/ plant)**

From results that are showed in Table (3, 4) the control treatment had significant differences among other herbicides treatments in the average of dry weight of biomass to plant canopy and total biomass, it was 2.46 and 6.19 gram per plant respectively while $T_3$ treatment recorded lower average which was 0.6500 and 2.16 gram/plant respectively. This may be due to trifluralin effects on the root growth inhibition reflected on the shoot tip reduction, additives injury degree was higher and it was more harmful for plants.

From the same table we can see that the treatments showed different effects on the average number of leaves per plant. The control treatment recorded significant differences in leaves number on comparison to other treatments, it was 23 leaves/plant. While, $T_5$ (diclofop-methyl) 0.88 kg a.i./ha showed the second higher number of leaves without significant difference with control treatment as compared with other herbicide treatments, it was 20.67. This result agreed with many studies that diclofop-methyl has minimum effects in the foliage of treated plants because the site of action of this group of herbicides emphasis Acetyl CoA Carboxylase (ACCase) inhibitors in grasses (Taberner *et al*., 2008). While, bentazone (1.44 Kg a.i./ha) and trifluralin (0.57 kg a.i./ha) treatments recorded a high decrease of leaf number by 15.67 and 15.67 respectively.

According to the Table 3, control treatment showed significant differences compared with the other treatments of herbicides in leaf area, it was 341 cm² while; trifluralin record lower average, 63 cm². That could be resulted from the harmful effects of the herbicide in the earlier times and higher injury degree. Moreover, the treatments showed different effects in plants height, that could be due to some herbicides, diclofop-methyl have the potential influence to work as growth regulators which records 19.33 cm² without much difference with the control 22 cm² while trifluralin treatment showed the lower plant height and branches which

**Table 4. Effects of herbicides on growth traits of broad bean**

| S. No | Treatment (herbicides) | Biological dry yield (gram)/plant | Canopy biomass (g/plant) weight | Roots weight gram/plant | Plants injury degree |
|---|---|---|---|---|---|
| 1 | $T_1$ (Control) | 6.19±0.38$^{a}$ | 2.46±0.30$^{a}$ | 3.73±1.69$^{a}$ | 0.00±0$^{bc}$ |
| 2 | $T_2$ (Bentazone) | 3.12±0.27$^{d}$ | 1.57±0.41$^{b}$ | 1.56±0.67$^{bc}$ | 1.00±0$^{b}$ |
| 3 | $T_3$ (Trifluralin) | 3.71±0.27$^{c}$ | 0.65±0.11$^{d}$ | 1.05±0.37$^{c}$ | 2.33±0$^{a}$ |
| 4 | $T_4$ (Clodinafop-propargyl) | 2.16±0.15$^{e}$ | 1.05±0.04$^{cd}$ | 1.11±0.29$^{c}$ | 2.33±0.57$^{a}$ |
| 5 | $T_5$ (Diclofop-methyl) | 4.38±0.20$^{b}$ | 1.57±0.04$^{b}$ | 2.96±1.59$^{ab}$ | 1.333±0.57$^{b}$ |
| 6 | $T_6$ (Diclofop-methyl) | 3.96±0.05$^{c}$ | 1.42±0.27$^{bc}$ | 2.39±0.83$^{abc}$ | 2.00±0$^{ab}$ |

*Similar litters indicate non significant differences; *Different litters indicate significant differences

were 10.67 cm² and three respectively. The reduction of root size and injury degree, depending on the level of the damage of caused by the herbicide. These results were in agreement with many studies reported that Trifluralin can cause inhibition in the plant growth especially in under special circumstances (Klingman *et al*., 1982)

**Root weight**

From the Table 4, the trifluralin (0.57 kg a.i./ha) recorded the lowest root weight average per plant and root size which were 1.05 g/plant and 1 $cm^3$ respectively. The reduction was highly significant compared to the control treatment 3.73g/plant, 5.9 $cm^3$. It is superior significantly to bentazone at, higher and lower rate of alloxan with no significant differences between both rates. Height and low average of Alloxan recorded 3.67 and 2.50 cm in pant root size and 2.96 and 2.39 g/plant of root weight, respectively. This may be due to the slight disturbance in the mitotic spindle formation which was affected by the herbicide (Yüzbaşioğlu *et al*., 2009) and in contrast that trifluralin herbicide group causes a reduction in root size especially when applied in high rate neither that diclofop-methyl (0.88 Kg a.i./ ha) in the lower average gave 2.96 g/p which didn't differ from the control treatment. This result agreed with many researchers view that diclofop-methyl is ineffective on broad bean root weight (Taberner *et al*., 2008)

## CONCLUSION

This preliminary study indicated that several herbicides have potential to negatively impact some of broad bean growth traits. Although most of the registered and unregistered herbicides showed no significant differences on compared to bentazone, diclofop-methyl has the least effects following bentazone with higher rates of most of the growth traits. Based on this preliminary work diclofop-methyl could be a promising herbicide to control grasses in broad bean. Although it has moderate side effects on beans which are still less than other herbicides, it could be used to control grasses in broad bean fields. However, more work should be done to investigate the herbicide-residual life time and the accumulation of the herbicides in the grain.

## REFERENCES

**Adam MZ, Ebad AF, Abo-El-Kheir Z and El-Sheikh AI. 1990.** Alterations in nucleic acids, protein content and mitotic division of *Vicia faba* root tip cells as affected by malathion and tamaron insecticides. *Cytologia*, 55 (3): 349-355.

**Agegnehu G, Ghizaw A and Tesfaye A. 2005.** Effect of tillage frequency and weed control on yield and yield components of faba bean in central highlands of Ethiopia. *Ethiopian Journal of Agricultural Sciences*, 18 (2): 165-172.

**Al-Ahmadi MS. 2013.** Cytogenetic effects of two synthetic pesticides on mitotic chromosome on root tip cells of *Allium cepa*. *Cytologia*, 78(1): 3-8.

**Al-Aidi MWS, Al-Dhahi HHK and Al-Timimi JAF. 2014.** Effect of nitrogenous fertilizers and agricultural sulfur addition on release of calcium and magnesium in some of Iraqi calcareous soils. *International Journal of Agricultural Science and Research*, 4(1): 59-63.

**Al-Chalabi FT. 1988.** Biological interactions between growth regulating substances and herbicides in weed control. PhD. Thesis, University College of North Wales, UK.

**Alagawadi AR and Reddy TKR. 1986.** Effect of trifluralin on *Rhizobium* and its nodulation on groundnut. *Pesticides*, 20(1): 27-28.

**Barbosa Machado NN, Prioli MR, Gatti AB and Mendes Cardos VJ. 2006.** Temperature effects on seed germination in races of common beans (*Phaseolus vulgaris* L.). *Acta Scientiarum Agronomy*, 28(2): 155-

164.

**Barker AV and Pilbeam DJ. 2015.** Handbook of plant nutrition. CRC press, 773 p.

**Dyck E and Liebman M. 1994.** Soil fertility management as a factor in weed control: the effect of crimson clover residue, synthetic nitrogen fertilizer, and their interaction on emergence and early growth of lambsquarters and sweet corn. *Plant and Soil*, 167(2): 227-237.

**Ghareeb A. 1998.** The mutagenic potentialities of the herbicide topogard using *Vicia faba* as a biological system. Vol. 3, In Proceedings Sixth Egyptian Botanical Conference, Cairo University, Egypt, 543-550 p.

**Klingman GC, Ashton FM and Noordhoff LJ. 1982.** Biology of weeds and weed seeds. Weed Science: Principles and Practices. 2nd ed., John Wiley & Sons, New York, USA, 449 p.

**Ljunggren H and Martensson A. 1980.** Herbicide effect on leguminous symbiosis. In Weeds and Weed Control. 21st Swedish Weed Conference, Uppsala. Sveriges Lantbruksuniversitet. 99-106 p.

**Moreland DE. 1967.** Mechanisms of action of herbicides. *Annual Review of Plant Physiology*, 18(1): 365-386.

**Solh MB and Pala M. 1990.** Weed control in chickpeas. *Weed Control in Chickpeas*, 9: 93-99.

**Stell RGU and Torrie JH. 1960.** Principles and procedures of statistics. New York: McGraw Hill Book Company, 481 p.

**Taberner PA, Cirujeda RA and Zaragoza LC. 2008.** Management of herbicide-resistant weed populations. 100 questions on resistance. Food and Agriculture Organization of the United Nations (FAO). 107 p.

**Yüzbaşioğlu D, Ünal F and Sancak C. 2009.** Genotoxic effects of herbicide Illoxan (diclofop-methyl) on *Allium cepa* L. *Turkish Journal of Biology*, 33(4): 283-290.