Research Journal of

Environmental Sciences

ISSN 1819-3412

Academic
Journals Inc.

www.academicjournals.com

Research Journal of Environmental Sciences 9 (6): 289-295, 2015
ISSN 1819-3412 / DOI: 10.3923/rjes.2015.289.295
© 2015 Academic Journals Inc.

Efficacy Evaluation of some Herbicides for Weed Management and Yield Attributes in Broad Bean (*Vicia faba*)

Zeinab Aboali and Saeed Saeedipour
Department of Agronomy, Shoushtar Branch, Islamic Azad University, Shoushtar, Iran

Corresponding Author: Saeed Saeedipour, Department of Agronomy, Shoushtar Branch, Islamic Azad University, Shoushtar, Iran

ABSTRACT

Weeds have always been considered strong competitors of crop plants; and today, they form an inseparable part of agronomic systems and inflict losses on crop plants. A field study was undertaken at Agronomy Research Farm, Islamic Azad University during 2011-12 to appraise the efficacy of some post spectrum herbicides against weed growth and their influence on growth and yield of broad bean. Treatment consisted of (1) Basagran SL 48% 1.5 L ha^{-1}+Haloxyfop-R-methyl EC 10.8% 0.6 L ha^{-1}, (2) Bentazon SL 48% 1.5 L ha^{-1}+Sethoxydim OEC 12.5% 1.5 L ha^{-1}, (3) Bentazon SL 48% 1.5 L ha^{-1}+Fenoxaprop-p-ethyl EC 12% 0.7 L ha^{-1}, (4) Imazthapyr SL 10% 0.6 L ha^{-1} and (5) Imazthapyr SL 10% 0.4 applied POST, with two control plots weed-free and weed-infested throughout the crop cycle, respectively. The experiment was replicated forth in a randomized complete block design. Compared with the weedy check, application of herbicides reduced weed biomass and increased broad bean biological and seed yield. Among herbicide treatments, imazthapyr with dose of 0.6 L ha^{-1} reduced weed dry matter by 98.7% and the lowest weed dry matter was observed with this treatment. Maximum broad bean biological yield was obtained in weed free check that was significantly different from other treatments. In comparison, among herbicide, maximum seed yield obtained with application of imazthapyr with dose of 0.6 L ha^{-1}, however, there was no statistical difference in seed yield among herbicide treatments.

Key words: Broad bean, herbicide, seed yield, weed dry matter

INTRODUCTION

Broad bean (*Vicia faba* L.) is grown and consumed principally in developing countries in Latin America, Africa and Asia. It is the most important legume worldwide for direct human consumption. The crop is consumed principally for its dry (mature) beans, shell beans (seeds at physiological maturity) and green pods. It is a major source of dietary protein that complements carbohydrate-rich sources such as rice, maize and cassava. It is also a rich source of dietary fibers, minerals and certain vitamins (Gepts *et al*., 2008). Farmers often consider weeds to be the major biological constraint to growing legume crops successfully. In fact, compared with cereals, legume species generally have an open growth habit and a slow growth rate in the early stages of the crop cycle, characteristics that favor the emergence and growth of weeds (Al-Thahabi *et al*., 1994; Smitchger *et al*., 2012). Weed interference in dry bean can reduce seed yield as much as 83% (Arnold *et al*., 1993; Malik *et al*., 1993; Chikoye *et al*., 1995) and can interfere with harvest efficiency and may cause staining and reduce seed quality (Burnside *et al*., 1994; Bauer *et al*., 1995; Urwin *et al*., 1996). Nowadays, the focus of attention is on controlling weed populations and not on

eradicating them. Chemical control of weeds became widespread in the world because it brings about rapid and desirable control of weeds and today chemical weed control is one of the most popular methods of controlling weeds. There is limited number of post emergence (POST) herbicides available for broad bean production. More research is needed to identify POST herbicides that provide broad leaved weed control in broad beans. One of the herbicides which can be applied in beans cultivation is bentazon, a photosynthesis II inhibitor. Khajehpour (2004) represented that applying 2-3 L ha^{-1} bentazon as post emergence herbicide in bean cultivation significantly reduces broad leaf weed infestations. Bentazon is a benzothiadiazole herbicide that can selectively control broad leaved weeds such as *Sinapis arvensis* L. (wild mustard), *Ambrosia artemisiifolia* L. (common ragweed), *Ambrosia trifida* L. (giant ragweed), *Polygonum persicaria* L. (ladysthumb), *Chenopodium album* L. (*Common lambsquarter* L.), *Amaranthus retroflexus* L. (redroot pigweed), *Abutilon theophrasti* Medic. (velvetleaf), *Portulaca oleracea* L. (purslane), *Raphanus raphanistrum* L. (wild radish), *Galinsoga ciliata* (hairy galinsoga), *Senecio vulgaris* (common groundsel), *Datura stramonium* L. (jimsonweed), *Xanthium strumarium* L. (cocklebur), *Capsella bursa-pastoris* (L.) Medic. (shepherdspurse) and *Stellaria media* (L.) Vill. (common chickweed) including group II and V resistant biotypes (Ontario Ministry of Agriculture and Food (OMAF, 2004; Vencill, 2002)). Sethoxydim and fenoxaprop-p-ethyl are herbicides that inhibit acetyl-CoA carboxylase (ACCase), the enzyme needed for fatty acid synthesis and subsequent production of phospholipids needed for cell membranes in plants. These herbicides can provide effective control of annual and perennial grass species such as *Panicum dichotomiflorum* Michx (fall panicum), *Echinochloa crusgalli* L. (barnyard grass), *Setaria viridis* (L.) Beauv. (green foxtail), *Digitaria sanguinalis* (L.) Scop. (large crabgrass), *Panicum miliaceum* L. (proso millet), *Panicum capillare* L. (witchgrass), *Elytrigia repens* (L.) Nevski (quackgrass) and *Zea mays* L. (volunteer maize) (OMAF, 2004; Vencill, 2002). Imazethapyr is an imidiazolinone herbicide that controls annual broadleaf and grass weeds including *Chenopodium album* L. (lambsquarters), *A. retroflexus*, *Sinapis arvensis* L. (wild mustard), *Ambrosia artemisiifolia* L. (common ragweed), *Abutilon theophrasti* Medic (velvetleaf), *Polygonum convolvulus* L. (wild buckwheat) and *S. ptycanthum* (Ontario Ministry of Agriculture, Food and Rural Affairs (OMAFRA, 2004; Vencill, 2002)). The objectives of this study were to evaluate the efficacy of some broadleaved herbicides applied POST at the proposed manufacturer's recommended rate and to assess broad bean yield response to these herbicides since no information is available in the literature on these chemicals.

MATERIALS AND METHODS

Field experiment was conducted in 2011-2012 at the Shoushtar Branch, Islamic Azad University, Iran (32°3'N, 48°50'E). The climate is arid and semi-arid with a mean annual rainfall of 321.4 mm and the average of annual minimum and maximum 9.5 and 46.3°C, respectively. The soil was a clay loam texture, pH of 7.4, soil electrical conductivity was 3.2 d sm^{-1} and 0.4% organic matter content. The available phosphorous and potassium were 10.4 and 155 ppm respectively. Seed bed preparation included moldboard plough followed by disking and land leveling. The experiment was performed in randomized complete block design with four replication. Treatment consisted of (1) Basagran (bentazon) SL 48% 1.5 L ha^{-1}+Haloxyfop-R-methyl (super gallant) EC 10.8% 0.6 L ha^{-1}, (2) Bentazon SL 48% 1.5 L ha^{-1}+Sethoxydim (nabo-S) OEC 12.5% 1.5 L ha^{-1}, (3) Bentazon SL 48% 1.5 L ha^{-1}+Fenoxaprop-p-ethyl (whip super) EC 12% 0.7 L ha^{-1}, (4) Imazthapyr (pursuit) SL 10% 0.6 L ha^{-1} and (5) Pursuit SL 10% 0.4 applied POST,

with two control plots weed-free and weed-infested throughout the crop cycle, respectively. Plots were 3 m wide (4 rows spaced 0.75 m apart) and 10 m long. Broad beans were planted 3-4 cm deep at the rate of 220,000 seed ha^{-1} in late November. Herbicide applications were made to 2-3 trifoliate leaf broad beans with a CO_2 pressurized backpack sprayer calibrated to deliver 200 L ha^{-1} of spray solution at a pressure of 200/240 kPa using low drift nozzles (ULD120-02, Spraying Systems Co., P.O. Box 7900. Wheaton, IL 60188). The boom was 2.5 m wide with six nozzles spaced 0.5 m apart. Plots were maintained weed free by cultivation and hand hoeing as required to eliminate the confounding effect of weed interference. Bean shoot dry weight was determined 2 weeks after treatment application by cutting plants at the soil surface from 1m of row per plot. Plants were dried at 60°C to constant moisture and then weighed. Broad bean height was measured for 10 plants in each plot 5 WAT and averaged. Broad bean was considered mature when 90% of the pods in the untreated control had turned from green to a golden color. Beans were harvested from each plot with a small plot combine, weight and seed moisture content were recorded and seed yields were adjusted to 13% moisture. Data was analyzed as an RCBD using PROC MIXED in SAS 9.2. Treatment comparisons were made using Fisher's Protected LSD at a level of $p<0.05$. Data compared on the transformed scale was converted back to the original scale for presentation of results.

RESULTS AND DISCUSSION

Weed control: Herbicide treatments applied to broad bean resulted in significant ($p \leq 0.05$) reduction in weed biomass and density relative to the untreated control (Table 1). The blend of Bentazon+Nobo-S and Pursuit with the dose of 0.6 L ha^{-1} has been more successful in the control of weed than other treatments and has decreased the weed biomass by over 98.7% in compare to weedy check. Other studies have found that 50 g ai ha^{-1} of imazethapyr (pursuit) applied post emergence will provide season-long control of broad leaf weed in pinto beans (Blackshaw and Esau, 1991). There was no statistical difference in weed control between pursuit applied alone or tank-mixed of Bentazon with Nobo-S (Table 2). The least level of control were observed in blend of Bentazon+Whip super and pursuit with the dose of 0.4 L ha^{-1} (Table 2). These results are similar to Blackshaw *et al*. (2000), who found that pursuit applied post-emergence at 20 or 35 g ai ha^{-1} as a follow up application to a grass herbicide provided good control of weed in dry beans. The need for different pursuit doses suggests that weed management in broad beans is dependent on weed species present (data not shown). Weed management practitioners must adjust pursuit herbicide doses based on weed species composition. Among experimental treatments there was a significant difference in terms of impact on the density of weed (Table 1). Mean comparison of treatments showed that pursuit with the dose of 0.6 L ha^{-1} decreased the density of weed by 66.2%. There was no statistical difference in weed control between pursuit applied alone with the blend of Bentazon+Super gallant or tank-mixed of Bentazon+Nobo-S (Table 2). The least impact was obtained from pursuit treatment with the dose of 0.4 L ha^{-1}.

Effect of treatments on plant height and leaf area index: Plant height and leaf area index were influenced by POST herbicide treatments (Table 3). Plant height is important in broad bean production as shorter plants may have greater shatter loss at the cutter bar of combine during harvesting resulting in reduced harvested seed yield. Plant height and leaf area index were reduced in the weedy treatment compared to the hand-hoeing treatment. The tallest and shortest plants were observed from the hand weeding and weedy check plots with 46.3 and 35.1 cm, respectively.

Table 1: Analysis variance of weed dry weight and number of weed per square meter 30 days after different post emergence herbicide application in field of broad bean

Variation source	Degree freedom	WDW	NWQ
Replication	3	805.86^{ns}	1.72^{ns}
Herbicide	5	66489.4**	3.99**
Error	15	936.62	1.64
CV (%)		11.43	10.23

WDW: Weed dry weight, NWQ: No. Of weed per square meter, CV: Coefficient of variation, ns: Not significant, **Significant

Table 2: Analysis variance of broad bean traits

Variation source	Degree of freedom	PH	LAI	PL	NPP	SNP	HSW	GY	BY	HI
Replication	3	6.14^{ns}	0.09^{ns}	4.56^{ns}	3.56**	0.204^{ns}	0.213^{ns}	9278.29^{ns}	597639.4^{ns}	0.262^{ns}
Herbicide	6	154.66**	0.363**	21.6**	39.31**	2.57**	50.59**	1035366.7**	11344591.2**	12.21**
Error	18	3.86	0.007	1.85	1.64	0.122	1.27	17008.9	418226.8	0.085
CV (%)		5.39	5.08	10.58	9.27	9.17	3.26	5.3	5.1	4.72

PH: Broad bean plant height, LAI: Broad bean leaf area index, PL: Broad bean pod length, NPP: No. of pod per broad bean plant), SNP: Broad bean seed number per pod, HSW: Broad bean 100 seed weight, GY: Broad bean grain yield, BY: Broad bean biological yield, HI: Broad bean harvest index at maturity under different post emergence herbicide treatments, ns: Not significant, *'**Significant at p<(0.05) and (0.01)

Table 3: Influence of herbicide treatments on different parameters

Herbicides (Trade name)	WDW (gm^{-2})	NWQ	PH (cm)	LAI	PL (cm)	NPP	SNP	HSW (g)	GY (kg ha^{-1})	BY (kg ha^{-1})	HI (%)
Hand weeding	-	-	46.3^{a}	2.85^{a}	17.47^{a}	18.75^{a}	5.42^{a}	96.18^{a}	3239.40^{a}	15513.4^{a}	20.87^{a}
Weedy check	347.70^{a}	120.05^{a}	35.1^{c}	1.75^{c}	10.55^{c}	8.75^{e}	2.78^{c}	85.08^{d}	1494.98^{c}	9776.4^{c}	15.29^{c}
Bentazon+Whip super	15.03^{b}	82.56^{b}	40.3^{b}	2.50^{b}	12.25^{bc}	15.50^{b}	3.78^{b}	88.90^{c}	2467.23^{b}	12601.1^{b}	19.58^{b}
Pursuit (0.6)	4.49^{b}	40.74^{c}	43.9^{b}	2.47^{b}	14.20^{b}	15.25^{bc}	3.91^{b}	92.83^{b}	2545.50^{b}	13184.4^{b}	19.32^{b}
Pursuit (0.4)	12.40^{b}	95.18^{b}	40.54^{b}	2.25^{bc}	12.31^{bc}	13.50^{cd}	3.72^{b}	91.96^{b}	2408.97^{b}	12527.6^{b}	19.22^{b}
Bentazon+Super gallant	4.93^{b}	53.03^{c}	41.5^{b}	2.50^{b}	11.53^{c}	12.00^{d}	3.50^{b}	92.86^{b}	2403.18^{b}	12256.1^{b}	19.61^{b}
Bentazon+Nabo-S	4.80^{b}	41.23^{c}	41.2^{b}	2.53^{b}	11.61^{c}	13.00^{d}	3.52^{b}	89.61^{c}	2540.51^{b}	12989.4^{b}	19.42^{b}
CV (%)	8.51	12.47	4.81	6.23	3.62	2.78	2.11	4.53	6.39	6.13	4.12

WDW: Weed dry weight, NWQ: No. of weed per square, PH: Broad bean plant height, LAI: Broad bean leaf area index, PL: Broad bean pod length, NPP: No. of pod per broad bean plant, SNP: Broad bean seed number per pod, HSW: Broad bean 100 seed weight, GY: Broad bean grain yield, BY: Broad bean biological yield, HI: Broad bean harvest index, Means are reported along with LSD values

All herbicide treatments decreased plant height and there was no statistical difference in plant height among herbicide treatments. Height reduction of broad bean plants not only shows competition with weeds but also confirms the inhibitory effect of herbicides on crops. Khan *et al.* (2003) reported that applying some herbicide applications did not affect plant height but other research (Marwat *et al*., 2003; Larik *et al*., 1999) observed that effects of various herbicides on plant height were significant.

Effect of treatments on pod number per plant: Comparison of means for pod number per plant showed significant differences among treatments (Table 3). The highest pod number per plant (18.75) was observed in weed free treatment. All herbicide treatments had less pod numbers than free weed control. The least pod number per plant was found in weedy check with a 53.3% decrease compared to weed free treatment (Table 2).

Opposite to that observed in Bentazon+Super gallant and pursuit with the dose of 0.6 L ha^{-1}, in other herbicides like weedy check treatment due to the lack of effectiveness of herbicide the pod number per plant decreased (Table 2).

Effect of treatments on seed number in pod and 100 seed weight: The effects of herbicide treatments on the seed number per pod was significant. Among treatments, the highest and the lowest seed number per pod were produced in weed free (5.42) and weedy check (2.78), respectively (Table 2). Increasing weed density decreased the pod number of broad bean, floret fertility and seed

number per pod maybe through shading effect of weed. The results indicated that if weeds are not controlled properly the negative effect of weed competition on the seed number of broad bean was increased. No significant differences was found in seed per pod among herbicide treatments (Table 2). The effect of herbicide treatments on 100 seed weight was similar to their effect on seed per pod. The highest and the lowest 100 seed weight was recorded in hand weeding and weedy check by 96.18 and 85.08 g, respectively. In comparison, the most effective herbicide in relation to100 seed weight was found in mixed tank of Bentazon+Super gallant that had no statistically differences with pursuit at both doses.

Effect of treatments on seed yield: Seed yield was equal in all POST herbicide treatments and there was no statistical difference in seed yield among herbicide treatments. The lowest and highest seed yield recorded 2403 and 2545 kg ha^{-1} in tank-mixed of Bentazon+Super gallant and pursuit with the dose of 0.6 L ha^{-1}, respectively (Table 2). In the weedy treatment seed yield was 1494.98 kg ha^{-1} and on hoeing treatment it was 3239 kg ha^{-1} (Table 2). Because the highest yield of herbicide treatments was only 78% of the hoeing treatment, it is likely that more efficient weed management programs can be developed. Higher seed yield in herbicide treated plots in compare to weedy check, may be an outcome of efficient weed control achieved there. These results are in conformation with those of Baghestani *et al*. (2008) and Chhokar *et al*. (2008), who reported that herbicides offer sizeable increase in crop productivity corresponding to their weed control spectrum. Behdarvandi and Modhaj (2007) reported that controlling weeds and decreasing their densities via reduction in plant competition (between rapeseed and weed), relied on appropriate radiation distribution in various layers of canopy and improvement in the micro climate could increase pods per plant, grains per pod and grain yield. Similar results were reported in other research (Yadav *et al*., 1995; Miri and Rahimi, 2009).

Effect of treatments on biological yield: Similar to seed yield, biological yield was equal in all POST herbicide treatments and there was no statistical difference in biological yield among herbicide treatments. The lowest and the highest biological yield recorded 12256.1 and 13184.4 kg ha^{-1} in tank-mixed of Bentazon+Super gallant and pursuit with the dose of 0.6 L ha^{-1}, respectively (Table 2). In the weedy treatment biological yield was 9776.4 kg ha^{-1} and on hand weeding treatment it was 15513.4 kg ha^{-1} (Table 2).

Effect of treatments on harvest index: The effect of treatments on harvest index was significant (Table 2). However, harvest index was equal in all POST herbicide treatments and there was no statistical difference in harvest index. The highest and lowest harvest index was observed in weed free and weedy check treatments by 20.87 and 15.29, respectively (Table 2).

CONCLUSION

It is concluded that the most effective herbicide treatment was pursuit with the dose of 0.6 L ha^{-1}, which provided maximum reduction in total weed dry matter. All herbicide treatments increased broad bean biological and seed yield as compared with the weedy check.

REFERENCES

Al-Thahabi, S.A., J.Z. Yasin, B.E. Abu-Irmaileh, N.I. Haddad and M.C. Saxena, 1994. Effect of weed removal on productivity of chickpea (*Cicer arietinum* L.) and lentil (*Lens culinaris* Med.) in a mediterranean environment. J. Agron. Crop Sci., 172: 333-341.

Arnold, R.N., M.W. Murray, E.J. Gregory and D. Smeal, 1993. Weed control in pinto beans (*Phaseolus vulgaris*) with imazethapyr combinations. Weed Technol., 7: 361-364.

Baghestani, M.A., E. Zand, S. Soufizadeh, M. Beheshtian and A. Haghighi *et al*., 2008. Study on the efficacy of weed control in wheat (*Triticum aestivum* L.) with tank mixtures of grass herbicides with broadleaved herbicides. Crop Protect., 27: 104-111.

Bauer, T.A., K.A. Renner, D. Penner and J.D. Kelly, 1995. Pinto bean (*Phaseolus vulgaris*) varietal tolerance to imazethapyr. Weed Sci., 43: 417-424.

Behdarvandi, B. and A. Modhaj, 2007. Integrated control (chemical and mechanical) of rapeseed weeds in Khouzestan climate (Iran). Res. J. Agric. Sci., 13: 163-170.

Blackshaw, R.E. and R. Esau, 1991. Control of annual broadleaf weeds in pinto beans (*Phaseolus vulgaris*). Weed Technol., 5: 532-538.

Blackshaw, R.E., J.L. Molnar, H.H. Muendel, G. Saindon and X. Li, 2000. Integration of cropping practices and herbicides improves weed management in dry bean (*Phaseolus vulgaris*). Weed Technol., 14: 327-336.

Burnside, O.C., W.H. Ahrens, B.J. Holder, M.J. Wiens, M.M. Johnson and E.A. Ristau, 1994. Efficacy and economics of various mechanical plus chemical weed control systems in dry beans (*Phaseolus vulgaris*). Weed Technol., 8: 238-244.

Chhokar, R.S., S. Singh and R.K. Sharma, 2008. Herbicides for control of isoproturon-resistant littleseed canarygrass (*Phalaris minor*) in wheat. Crop Prot., 27: 719-726.

Chikoye, D., S.F. Weise and C.J. Swanton, 1995. Influence of common ragweed (*Ambrosia artemisiifolia*) time of emergence and density on white bean (*Phaseolus vulgaris*). Weed Sci., 43: 375-380.

Gepts, P., F. Aragao, E. de Barros, M.W. Blair and R. Brondani *et al*., 2008. Genomics of *Phaseolus* Beans, a Major Source of Dietary Protein and Micronutrients in the Tropics. In: Genomics of Tropical Crop Plants, Moore, P. and R. Ming (Eds.). Springer, Berlin, Germany, pp: 113-143.

Khajehpour, M., 2004. Industrial Plants. Esfehan University Jahad Daneshgahi Press, Tehran, Iran, (in Farsi).

Khan, I.A., G. Hassan and Ihsanullah, 2003. Efficacy of pre-emergence herbicides on the yield and yield components of canola. Asian J. Plant Sci., 2: 251-253.

Larik, A.S., M. Rajput, A.A. Kakar, S.S. Bukhari and M.A. Shaikh, 1999. Effect of weedicide afaon on character association in *Brassica juncea* and *Eruca sativa*. Sarh J. Agric., 15: 198-202.

Malik, V.S., C.J. Swanton and T.E. Michaels, 1993. Interaction of white bean (*Phaseolus vulgaris* L.) cultivars, row spacing and seeding density with annual weeds. Weed Sci., 41: 62-68.

Marwat, K.B., Z. Hussain, N.I. Khan and B. Gul, 2003. Impact of weed management on rapeseed. Pak. J. Weed Sci. Res., 9: 207-214.

Miri, H.R. and Y. Rahimi, 2009. Effects of combined and separate herbicide application on rapeseed and its weeds in southern Iran. Int. J. Agric. Bio., 11: 257-260.

OMAF., 2004. Guide to Weed Control. Ontario Ministry of Agriculture and Food, Toronto, Ontario, Canada, pp: 348.

OMAFRA., 2004. Guide to Weed Control. Ontario Ministry of Agriculture, Food and Rural Affairs, Toronto, Ontario, pp: 347.

Smitchger, J.A., I.C. Burke and J.P. Yenish, 2012. The critical period of weed control in lentil (*Lens culinaris*) in the pacific Northwest. Weed Sci., 60: 81-85.

Urwin, C.P., R.G. Wilson and D.A. Mortensen, 1996. Response of dry edible bean (*Phaseolus vulgaris*) cultivars to four herbicides. Weed Technol., 10: 512-518.

Vencill, W.K., 2002. Herbicide Handbook. 8th Ed., Weed Science Society of America, Champaign, IL., ISBN-13: 9781891276330, Pages: 493.

Yadav, R.P., U.K. Shrivastava and K.S. Yadav, 1995. Yield and economic analysis of weed-control practices in Indian mustard (*Brassica juncea*). Indian J. Agron., 40: 122-124.