INNSPUB

International Journal of Biosciences | IJB |
ISSN: 2220-6655 (Print) 2222-5234 (Online)
http://www.innspub.net
Vol. 4, No. 12, p. 186-192, 2014

RESEARCH PAPER OPEN ACCESS

Separate and combined application of herbicide in bean weeds control and its yield

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Key words: Bean, chemical control, gallant, treflan, bentazone

http://dx.doi.org/10.12692/ijb/4.12.186-192 Article published on June 22, 2014

Abstract

Prevalent presence of weeds in bean fields means that it is necessary that new herbicide adopt for weed control in this crop. In order to evaluate the effects of gallant (hexafop methyl) Treflan (trifluralin) bentazone herbicides on bean and its weeds an experiment was conducted in 2013 using Randomized Complete Blocks Design with three replications. Seven herbicide treatments included: 1) gallant, 2) treflan, 3)bentazone, 4) gallant + treflan, 5) gallant+ bentazone, 6) bentazone+ treflan, 8) gallant+ treflan+ bentazone and 9) weedy check were used in the experiment. The results showed that combined application of herbicides had a better effect on weed control compared to separate application of each of them. Combined application of three herbicides significantly increased pod number (12.14 pod per plant) and seeds per pod (6 seeds) the lowest weeds density and dry weight also obtained in treatment of gallant+ treflan+ bentazone. In conclusion the results showed that the use of combined application had better performance in bean weed control and can be recommended as an alternate application instead of separate application of herbicides in similar conditions.

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Introduction

Weeds are the main competitor of crops that compete for light, water and nutrients. Weeds are unwanted plants that interfere with cultural practice, decrease crop yield and increase production costs. In general weeds reduced crop yields by 25-30percent (Baghestani *et al*., 2003). Weed control programs adopt based on the regional condition included weed flora.

Bean (*Phaseolus vulgaris*) is one of the main grain seed crop supplying human. It has been originated from America and extensively grown in many areas of the world (Haji Aghaei and Bozorgi, 1997). Bean is a weak competitor because of slow early growth and is sensitive to seed damage and therefore early weed control in bean is necessary.

Weed flora in bean fields differed based on the region but the most prevalent weeds are barnyard grass (*Echinocloa crusgalli*) fall panicum (*panicum dichotomiflorum*) pigweed (*Amaranthus sp*.), lambsquarters (*Chenopodium album*), jomson weed (*Daturea stramonium*), fix weed (*Descurainia Sophia*), cocklebur (*Xanthium strumarium*) and nightshade (*Solanum nigrom*) (Kochaki *et al*., 1994). Weak completion ability of bean is illustrator of importance of weed control and economically efficient production of bean require good weed control in this crop (Soltani *et al*., 2006).

Herbicides are one of the most important of inputs of agricultural system and a considerable portion of crop yield is due its consumption in crop production (Powel *et al*., 1997). Today herbicide because of its efficiency and economic advantage play a key role in weed management and extensively used in agriculture. In many experiments it was shown that herbicide control weeds by 80 to 100% (Donald, 2007). In Iran yet seven herbicides (i.e. treflan, sonalan, lasso, dactal, eradicane, bazagrane and gallant) had been registered for weed control in bean (Zand *et al*., 2007). Preplanting soil incorporated application of imazethapyr effectively control broad leaved and grasses weeds in some grain crop some soybean and bean (Arnold *et al*., 1993). In another evaluation application imazethapyr in addition with metolachlor, trifluralin and pendimenthalin show a good control against weeds (Arnold *et al*., 1996).

There are little registered herbicides for post emergence weed control in bean. The lack of appropriate herbicide for broad leaved weed control in bean caused increasing cultivator and hand weeding costs (Soltani *et al*., 2004). Bentazon is the only herbicide that for many years used for weed control in bean. Bentazone is a selective post emergence herbicide which effectively control some broad leaved weed such as lambsquarters, pigweed, jimson weed, wild mustard (*Sinapis arvensis*), purslane (*Portulaca oleracea*), common mallow (*Abutilon theophrasti*) and knot weed (*Polygonum avicular*) (Zand *et al*., 2006).

Due to low diversity of registered broad leaved herbicides in Iran and high diversity of this weeds it is necessary that new herbicide evaluate and register for weed control in bean. One of the most effective management in delaying herbicide resistance in weeds is herbicide rotation and combination of herbicides with different mode of action. Although ALS inhibitors herbicide recently as an effective and new tool adopted in weed control programs, unfortunately resistance to these herbicides developed faster than other herbicide (Baghestani *et al*., 2003).

Against farmer tendency to extensive use of herbicides nowadays attention to reducing herbicides usage and dose was regarded. Appearance of herbicides resistance and increasing environmental problem are important causes that lead to attention to reducing herbicides usage (Blackshaw *et al*., 2006). Weed control not only restrict to remove or reduce growth of weeds in an area but also the aim of sustainable weed management must be prevention of occurrence of resistance weed using chemical ad cultural rotation (Hatizois and Penner, 1985).

By considering the need of weeds control in bean and

]high weed existence in its fields the aim present study was, 1) evaluation of efficiency of treflan, gallant and bentazon herbicides in weed control, 2) economic and optimum use of herbicide for increase bean yield and 3) combined application of herbicides in order to increase control spectra of these herbicides.

Materials and methods

Experimental conditions

The experiment was conducted in 2013 in Sepidan city with 30° 45´ latitude, 52° 00´ longitude and elevation of 2201 m above sea level. The soil was silty loam with pH= 7.11, EC= 2.17ds/m and 0.5% organic matter.

Experimental design

The experiment was conducted in Randomized Completely Blocks Design with three replications. The applied herbicides were gallant (1 L/ha), treflan (2.5 L/ha) and bentazone (2.5 L/ha). Eight treatments applied in the experiment which were included, 1) gallant, 2) treflan, 3) bentazone, 4) gallant+ treflan, 5) gallant+ bentazone, 6) bentazone+ treflan, gallant+ treflan+ bentazone and 8) weedy control. Each plot was 12m² with 0.5 m space between plots and 1m between replications.

Cultural practice

The soil was plowed in spring and 300 kg/ha urea and 150 kg/ha ammonium phosphate and potassium sulfate was added and incorporated with soil. Urea fertilizer splited and applied in three times (1/3 at sowing, 1/3 at seedling growth and (1/3 before flowering). After treated with fungicide bean seeds (cv. Khomein) hand sown at depth of 3 cm and 5cm intra row space.

Herbicide application

Herbicides applied at the mentioned rates at appropriate times (namely treflan as pre planting incorporated with soil and gallant and treflan at 4th leaved stages of weeds). The most prevalent weeds observed at fields during experiment were *Amaranthus retroflexus, Convolvulus arvensis, Chenopodium album, Portulaca oleracea, Malva neglecta, Centaurea depressa*.

Measurements of weed and crop traits

For measuring weeds density after a week after application of herbicides using a 0.5*0.5 m sampler the number of weed counted in each plots. Then weed harvested in plots and after drying in 72° C for 48 in oven weighted.

For measuring pod number in bean, 10 plants were harvested in each plot and pod number in each plant counted. For measuring seed number per pods in 40 randomly selected pod seeds number were counted. Bean grain yield was measured by harvesting 1.5 m² of each plots and separating seeds from plants materials.

Data analysis

Data were subjected to ANOVA using SAS software and mean compared using Duncan's multiple range test at 5% level.

Results and discussion

Pigweed density and dry weight

Pig weed density and dry weight significantly affected by herbicides. Weedy control had the highest density (14 plant/ m²) (Fig 1) and dry weight (175.12 g/m²) (Fig 2). All herbicides treatment significantly reduced pig weed weight and density. Separate application of gallant caused the lowest pigweed density. After this bentazone showed the lowest pigweed density. Treatments of gallant+ bentazone and treflan+ bentazone produced the lowest (3 plant/m²) pigweed density. Application of three herbicides together reduced pigweed number to 1 plant/m².

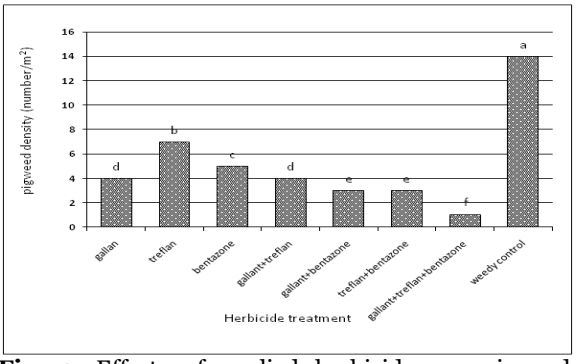

Fig. 1. Effects of applied herbicides on pigweed density.

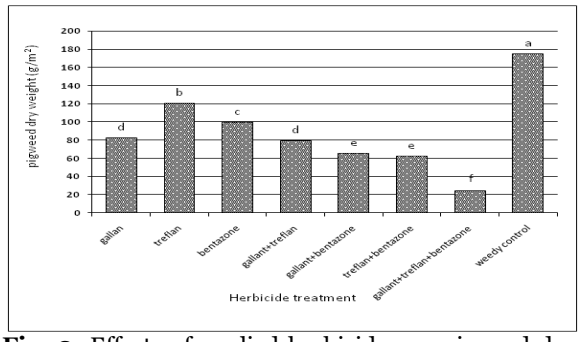

Fig. 2. Effects of applied herbicides on pigweed dry weight.

According to Fig 2 all herbicides reduced pigweed dry weight. Combined application of herbicides caused more reduction in pigweed weight in comparison to separate application of each herbicide. The lowest (24.51 g/m²) pigweed dry weight obtained in gallant+ bentazone+ treflan treatments.

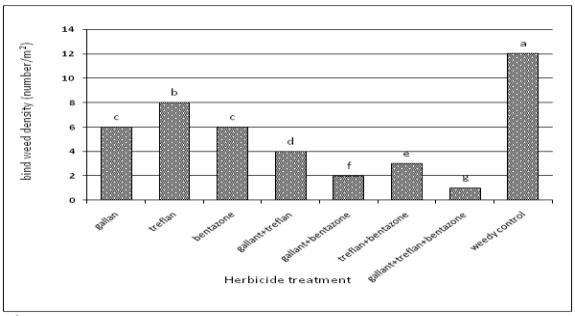

Fig 3. Effects of applied herbicides on bind weed density.

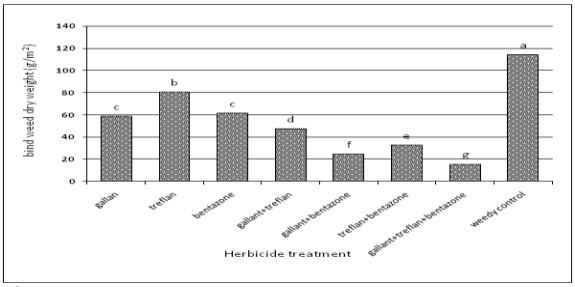

Fig. 4. Effects of applied herbicides on bind weed dry weight.

Hart *et al.* (1997) reported that by post application of imazethapyr in soybean density weight reduced by 88%. Amador-Ramirez *et al.* (2001) also showed that combined application of imazethapyr+ bentazone reduced weed density by 62% which this difference can be due different weed flora in each region. Bahari *et al.* (2011) evaluated the mixed application of MCPA and nicosulfuon at 15, 30 and 45 days spraying significantly reduced broad leaved and grass weeds and combined application of two herbicides were superior and separate application of them.

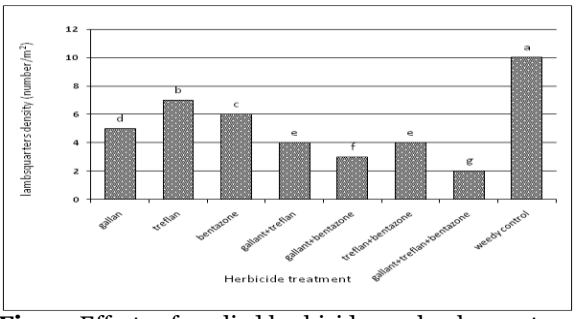

Fig. 5. Effects of applied herbicides on lambsquarters density.

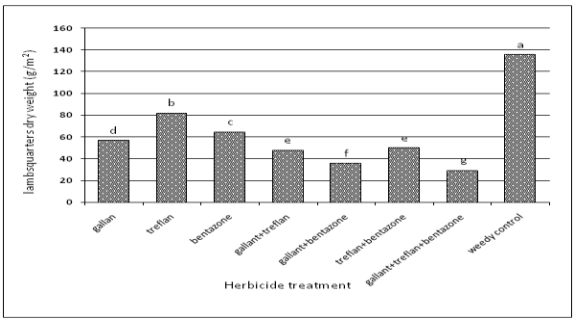

Fig. 6. Effects of applied herbicides on lambsquarters dry weight.

Bind weed density and dry weight

Weedy control showed the lowest density (12 plant/m²) and dry weight (114.39 g/m²) bind weed density (Fig 3 and 4). In separate application of herbicides, treflan showed the weak control on pigweed while bentazone and gallant showed the better control and reduced pigweed density by 6 plants/m². Combined application showed more severe reduction in pigweed density and gallant+ bentazone was the best double combination of herbicides which reduced its by 2 plant/m². After this treatment gallant+ bentazone and gallant+ treflan showed good control on pigweed. Application of treflan+ gallant+ bentazone showed the lowest pigweed density and dry weight as reduced its density to 1 plant/m² and its dry weight to 15 g/m (Fig 3 and 4). Esfandiari *et al.* (2005) evaluated application of different herbicides in bean weed control and showed that all herbicide except alachlor reduced barnyard grass growth but the was no significant differences between herbicides. It seems that combination of herbicides in addition to better weed control prevents

from resistance to a specific herbicide. Similar results reported by Esfandiari and Hashemi (2005) and Kevin *et al.* (2001).

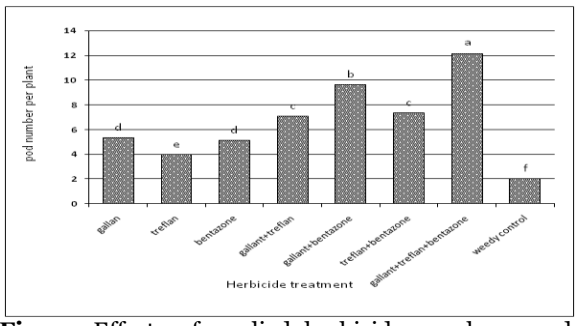

Fig. 7. Effects of applied herbicides on bean pod number.

Lambsquarters density and dry weight

Dry weight and density of lambsquarters significantly affected by herbicide treatments. Weedy control showed the highest density and dry weight of lambsquarters and all applied herbicide reduced these traits (Fig 5 and 6). In separate application of herbicides treflan showed weak control on weed while gallant showed better control. In double combinations gallant+ bentazone showed the best control and reduced lambsquarters number to 3 plants/m² and dry weight to 35g/m². There was no significant difference between gallant+ treflan and treflan+ bentazone. Application of gallant+ treflan+ bentazone caused the lowest number (2plants/m²) and dry weight (28.6g/m²) of lambsquarters. In other experiments has been shown that application of herbicides reduced weed dry weight and density. For example Ghiasvand *et al.* (2009) showed that application of foramsulfuron reduced weed dry weight by 48.13%. Mosavi *et al.* (2011) showed that molinate application in rice reduced barnyard grass density and increased rice competitiveness.

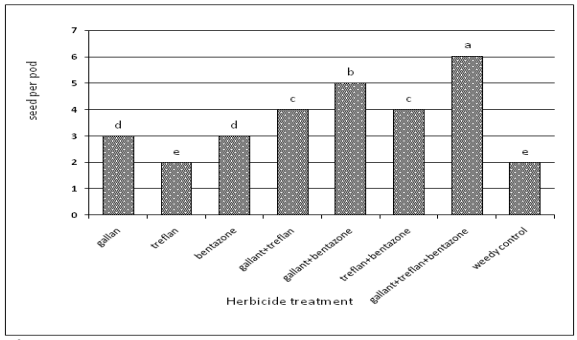

Fig. 8. Effects of applied herbicides on bean seed number.

Number of pods

Pod number affected by herbicides (Fig 7). The lowest pod number (2.03 pods per plant) observed in weedy control which due to high weeds density it was predicable. In separate applications there was no significant difference between bentazone and gallant and these two herbicides produced higher pos than treflan. In combination of two herbicides the highest pod number (9.65 pods per plants) observed by application of gallant+ bentazone. Application of gallant+ bentazone+ treflan produced 12.14 pods per plant. Mousavi *et al.* (2011) evaluated effects of combination of fomesafen, bentazone and acyloflrurofen on weed control in bean and showed that combination of herbicides caused better control of grass and broad leaved weeds. Similar results observed by Arnold *et al.* (1993).

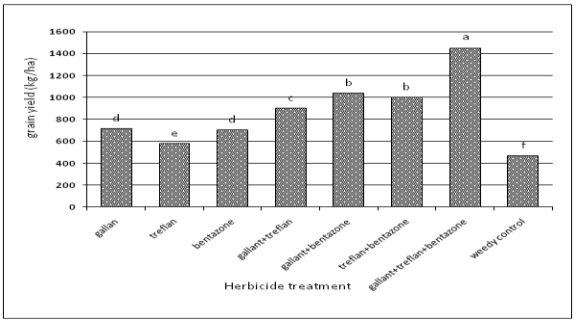

Fig. 9. Effects of applied herbicides on bean grain yield.

Seed number per pod- Pod number significantly affected by herbicides treatments (Fig 8). Weedy control and treflan treatments produced the lowest seed number. This means that treflan had a low efficiency in weed control but separate application of bentazone and gallant produced higher seed number (3 seeds per pod) than treflan. Application of gallant+ bentazone produced more seeds than other application of two herbicides. The highest seed number obtained in gallant+ bentazone+ treflan which produced 6 seed per pod. This was due better control of weeds in combined application of herbicides which resulted in better growth of bean and increased photosynthates and therefore yield components. Bazazi (2005) similarly showed that pyridate herbicides control weeds and increased yield components of lentil. He reported that by one spraying with pyridate lentil yiled increased by 27%.

Grain yield

The lowest grain yield (512.36 kg/ha) observed in weed control while application of gallant+ bentazone+ treflan increased bean grain yield to 1449.32 kg/ha (Fig 9). This shows that weed can reduce bean yield by more than 60%. Application of herbicides reduced weed density and increased grain yield of bean. In separate application of herbicides treflan produced lower yields due weak control of weeds. In application of combined herbicides gallant+ bentazone showed better performance than other two combined herbicide. The results of grain yield show that bean is a weak competitor against weeds and cannot produced good yield without appropriate weed control. Mousavi *et al.* (2011) also showed better weed control in bean by application of combined herbicides.

Conclusion

In conclusion the results of this experiment showed that weed can severely reduce bean yield and yield components. Although separate application of herbicides reduce weed density and dry weight and increased bean yield compared to weedy control, application of combined herbicides showed better performance so the highest grain yields and yield components observed in combined application of gallant+ bentazone+ treflan. Application of combined herbicides besides good weed control may reduce likelihood of resistance to herbicides. Therefore for appropriate weed control and obtaining good yield in bean in similar condition combined application of gallant+ bentazone +treflan or gallant+ bentazone can be recommend.

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