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# Integrated Weed Management in Asgandh ( *Withania somnifera* Dunal)

**G. S. Kulmi and P. N. Tiwari**
K. N. K. College of Horticulture
J. N. K. V. V., Mandsaur-458 001 (Madhya Pradesh), India

## ABSTRACT

The highest weed control efficiency (96.7%), dry root yield (558 kg $ha^{-1}$), seed yield (506 kg $ha^{-1}$) and net profit (Rs. 18,450 $ha^{-1}$) were recorded with three weedings at 20, 40 and 60 days after sowing (DAS), followed by pre-emergence application of isoproturon at 0.50 kg $ha^{-1}$+weeding at 45 DAS which was followed by glyphosate at 1.0 kg $ha^{-1}$+weeding at 45 DAS. Unchecked weed growth caused 57.2% loss in dry root yield and 53.6% loss in seed yield of asgandh. Higher doses of isoproturon (0.75 kg $ha^{-1}$) and glyphosate (1.5 kg $ha^{-1}$) gave 8.6 and 13.4% phytotoxicity to asgandh crop, respectively.

## INTRODUCTION

Asgandh (*Withania somnifera* Dunal) is also known as aswagandha or winter cherry belongs to Solanaceae family. It is an important medicinal crop cultivated mainly in North-Western region of Madhya Pradesh on marginal land on about 4000 ha area as late rainy (**kharif**) season crop. Its roots, bark, leaves and seeds are used in various Ayurvedic and Unani medicines. The roots contain alkaloids mainly withanines which are used for the preparation of many vital tonics (Prajapati *et al.*, 2003). Due to slow initial growth, poor canopy cover and deep root system, asgandh crop is badly infested by weeds at early stages of its growth and many times a complete failure of the crop occurs. Hand weeding is one of the most effective weed control measures but the non-availability of labourers and high cost involved therein, hinder the timely removal of weeds. Integrated weed management system is the coordinated management of weed population with effective, dependable and workable management techniques, which are economically sound and environmentally friendly in improving and sustaining the agricultural productivity (Foy, 1993). This situation necessitates developing an effective and economic integrated weed control practice for asgandh. The present investigation was, therefore, initiated.

## MATERIALS AND METHODS

Field study was conducted during late rainy (**kharif**) seasons of 1999 and 2000 at K. N. K. College of Horticulture, Mandsaur under All India Coordinated Research Project on Medicinal and Aromatic Plants on clay loam soil (0.51% organic carbon, 271.4, 10.3 and 507.9 kg $ha^{-1}$ available N, P and K, respectively with 7.3 pH). Twelve treatments were tried in a randomized block design with three replications in a gross plot size of 2.4 m x 4.0 m (Table 1). Three doses of isoproturon (0.25,0.50 and 0.75 kg $ha^{-1}$, as pre-emergence) and two doses of glyphosate (1.0 and 1.5 kg $ha^{-1}$, as pre-emergence at 2 days after sowing) each alone and supplemented with weeding at 45 days after sowing (DAS) were tested and these were compared with three weedings at 20, 40 and 60 DAS and weedy plots. The herbicides were applied with a manualiy operated knapsack sprayer fitted with flat fan T-jet nozzle at spray volume of 800 l $ha^{-1}$. Asgandh variety JA-20 was seeded at 6 kg seeds $ha^{-1}$ in row spaced at 30 cm in the second week of August during both the years. The crop was fertilized with 20 kg N, 40 kg $P_2O_5$ and 20 kg $K_2O$ as basal. The digging of roots was done in second week of February during both the years. Visual scores of grading of roots were done for judging root quality just after digging on the basis of 5 scale, where 1=Unbranched, starchy, unshrinked and rounded roots, 2=Unbranched, starchy, unshrinked and unrounded roots, 3=Branched, starchy, unshrinked and unrounded roots, 4=Branched, non-starchy/woody, shrinked and unrounded roots and 5=Branched, non-starchy/woody, shrinked, unrounded and hollow roots. Density and total

Table 1. Effect of isoproturon and glyphosate on weed density (Mean of two crop seasons) and total weed biomass in asgandh

| Treatment | Dose (g ha$^{-1}$) | Weed density (No. m$^{-2}$) 60 DAS | | | | | Total weed biomass (g m$^{-2}$) 60 DAS | | |
|---|---|---|---|---|---|---|---|---|---|
| | | *D. arabica* | *E. crusgalli* | *P. minima* | *C. oletorius* | Others | 1999-2000 | 2000-01 | Mean |
| Weedy | | 101 | 19 | 16 | 15 | 51 | 126.8 | 136.4 | 131.6 |
| Three weedings 20, 40 & 60 DAS | | 6 | 1 | 1 | 1 | 3 | 2.5 | 6.2 | 4.3 |
| Isoproturon | 250 | 57 | 11 | 9 | 9 | 29 | 106.1 | 116.6 | 111.3 |
| Isoproturon | 500 | 46 | 9 | 7 | 7 | 23 | 97.3 | 105.8 | 101.5 |
| Isoproturon | 750 | 40 | 7 | 6 | 6 | 20 | 95.5 | 105.2 | 100.3 |
| Isoproturon fb weeding 45 DAS | 250 | 14 | 3 | 2 | 2 | 7 | 5.0 | 9.3 | 7.1 |
| Isoproturon fb weeding 45 DAS | 500 | 10 | 2 | 2 | 2 | 5 | 4.3 | 8.3 | 6.3 |
| Isoproturon fb weeding 45 DAS | 750 | 8 | 1 | 1 | 1 | 4 | 3.7 | 7.3 | 5.5 |
| Glyphosate | 1000 | 71 | 13 | 11 | 11 | 36 | 116.1 | 121.5 | 118.3 |
| Glyphosate | 1500 | 64 | 12 | 10 | 10 | 32 | 93.6 | 99.8 | 96.7 |
| Glyphosate fb weeding 45 DAS | 1000 | 17 | 3 | 3 | 3 | 9 | 15.6 | 21.8 | 18.7 |
| Glyphosate fb weeding 45 DAS | 1500 | 15 | 3 | 2 | 2 | 8 | 10.6 | 13.5 | 12.0 |
| LSD (P=0.05) | | 10.0 | 2.3 | 1.6 | 1.5 | 5.0 | 45.6 | 44.9 | 45.1 |

fb–followed by.

biomass of weeds were recorded at 60 DAS with the help of 0.25 m$^2$ quadrate by throwing it randomly at four places from each plot. Economics of different weed control treatments was worked out on the basis of prevailing market prices.

## RESULTS AND DISCUSSION

### Effect on Weeds

The predominant weeds of experimental field were *Dinebra arabica* (49.9%), *Echinochloa crusgalli* (9.3%), *Physalis minima* (8.1%), *Corchorus oletorious* (7.5%), *Digera arvensis* (5.9%), *Acalypha indica* (4.8%) and *Xanthium strumarium* (4.5%). Other weeds (10%) such as *Dinebra retroflexa, Digitaria sanguinalis, Cyperus rotundus, Eclipta alba, Phyllanthus niruri* and *Commelina bengalensis* were low in density.

All the weed control treatments caused significant reduction in density and dry biomass of various weeds as compared to weedy (Table 1). Three weedings at 20, 40 and 60 DAS showed highest weed control efficiency (96.7%). It was at par with pre-emergence application of isoproturon at 0.75, 0.50 and 0.25 kg ha$^{-1}$ each supplementred with one weeding at 45 DAS. Integration of isoproturon with weeding showed superiority over its sole application. Glyphosate at 1.5 and 1.0 kg ha$^{-1}$ as pre-emergence coupled with one weeding at 45 DAS proved effective in reducing population and dry biomass of various weeds (NRCMAP, 2001). Sole application of both the herbicides utterly failed to reduce weed dry biomass yield.

### Effect on Crop

Uncontrolled weeds resulted in 57.2% reduction in dry root yield and 53.6% reduction in seed yield of asgandh. The highest root quality, dry root and seed yields were recorded under three weedings at 20, 40 and 60 DAS, followed by isoproturon at 0.50 kg ha$^{-1}$ and glyphosate at 1.0 kg ha$^{-1}$ each supplemneted with one weeding at 45 DAS (Table 2). It was mainly attributed to better control of weeds

Table 2. Effect of treatments on asgandh root yield, root quality and economics (Mean of two crop seasons)

| Treatment | Dose (g ha$^{-1}$) | Dry root yield (kg ha$^{-1}$) | | | Seed yield (kg ha$^{-1}$) | | | Root quality grade | Additional cost over weedy (Rs. ha$^{-1}$) | Additional return over weeding (Rs. ha$^{-1}$) | B : C ratio |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1999-2000 | 2000-01 | Mean | 1999-2000 | 2000-01 | Mean | | | | |
| Weedy | | 203 | 234 | 218 | 162 | 240 | 201 | 3.0 | - | - | - |
| Three weedings 20, 40 & 60 DAS | | 703 | 413 | 558 | 662 | 351 | 506 | 2.0 | 5000 | 23450 | 3.69 |
| Isoproturon | 250 | 333 | 259 | 296 | 180 | 245 | 212 | 3.0 | 259 | 4790 | 17.49 |
| Isoproturon | 500 | 342 | 283 | 312 | 259 | 290 | 274 | 2.3 | 368 | 6370 | 16.30 |
| Isoproturon | 750 | 333 | 277 | 305 | 236 | 265 | 250 | 2.3 | 477 | 5750 | 11.05 |
| Isoproturon fb weeding 45 DAS | 250 | 532 | 290 | 411 | 402 | 290 | 346 | 3.0 | 1509 | 13030 | 7.63 |
| Isoproturon fb weeding 45 DAS | 500 | 643 | 382 | 512 | 574 | 314 | 444 | 2.0 | 1618 | 18210 | 10.25 |
| Isoproturon fb weeding 45 DAS | 750 | 509 | 308 | 408 | 314 | 296 | 305 | 2.3 | 1727 | 12440 | 6.20 |
| Glyphosate | 1000 | 268 | 277 | 272 | 166 | 259 | 212 | 3.0 | 1053 | 4550 | 3.32 |
| Glyphosate | 1500 | 287 | 283 | 285 | 217 | 271 | 244 | 3.0 | 1504 | 4450 | 1.95 |
| Glyphosate fb weeding 45 DAS | 1000 | 587 | 320 | 453 | 425 | 314 | 369 | 2.3 | 2303 | 17640 | 6.65 |
| Glyphosate fb weeding 45 DAS | 1500 | 564 | 302 | 433 | 398 | 304 | 351 | 3.0 | 2754 | 8400 | 2.05 |
| LSD (P=0.05) | | 232 | 49 | 127 | 189 | 115 | 163 | 0.4 | - | - | - |

fb–followed by.

Prevailing market price (Rs./kg) : Dry root 60, seed 10, isoproturon 330, glyphosate 370 and labour charges 50/day/labourer.

owing to integration of herbicides with manual weeding. Higher doses of isoproturon (0.75 kg $ha^{-1}$) and glyphosate (1.5 kg $ha^{-1}$) caused 8.6 and 13.4% toxicity to the crop, respectively. Isoproturon at 0.25 kg $ha^{-1}$ coupled with weeding at 45 DAS proved significantly superior over weedy and sole application of both the herbicides for dry root and seed yields. The sole application of isoproturon (0.25-0.75 kg $ha^{-1}$) and glyphosate (1.0-1.5 kg $ha^{-1}$) failed to improve root and seed yields of asgandh because of poor control of weeds.

**Economics**

Maximum net profit of Rs. 18,450 $ha^{-1}$ was recorded with three weedings at 20, 40 and 60 DAS, followed by isoproturon at 0.50 kg $ha^{-1}$ (Rs. 16,592 $ha^{-1}$) and glyphosate at 1.0 kg $ha^{-1}$ (Rs. 15,337 $ha^{-1}$) each integrated with one weeding at 45 DAS (Table 2). Isoproturon at 0.25 kg $ha^{-1}$ gave highest benefit : cost ratio (17.49), followed by its doses of 0.50 kg $ha^{-1}$ (16.30) and 0.75 kg $ha^{-1}$ (11.05).

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