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**Mohamed Abdelwhab Khodary**
**Mohamed Abdel Aziz Balah**
Plant Protection Department
Desert Research Center
Cairo
Egypt
11753

**Ahmed Ahmed Sallam**
Plant Protection Department
Faculty of Agriculture
Sohag University
Sohag
Egypt
82524

**Corresponding author:**
**Ahmed Ahmed Sallam**
asallam3@yahoo.com

# Enhancement *Imperata cylindrica* (L.) chemical control with fluazifop-butyl and glyphosate using some additives

**Mohamed Abdelwhab Khodary, Ahmed Ahmed Sallam and Mohamed Abdel Aziz Balah**

**Abstract**

Halfa or Cogongrass or speargrass (*Imperata cylindrica* (L.) Beauv.) is a perennial weed invading throughout the tropical and subtropical regions over the world. It causes many indirect environmental and economic problems and it's difficult to control. Therefore, two field experiments were conducted in Toshka Research Station, Desert Research Center, Egypt during 2018/2019 and 2019/2020 summer seasons (July and August) to evaluate the efficacy of fluazifop-p-butyl (inhibiting lipid synthesis) and glyphosate (disrupts the shikimic acid pathway through inhibition of the enzyme 5-enolpyruvylshikimate-3-phosphate (EPSP) synthase) and some additives against this weed. In binary mixture trials, the recoded reduction in re-sprout of *I. cylindrica* rhizome at (2000 and 4000 ppm) of glyphosate and fluazifop-p-butyl alone and in combination with additives. Glyphosate plus gibberellic acid (GA3) reached (71.43and 85.71%), glyphosate and glycerin mixture (70.43 and 72.43%) while, glyphosate alone (28.57and 42.86%) respectively as compared with control. Under field condition, results showed that, the maximum reduction in dry weights of the *I. cylindrica* were (81.67%) at ½ rate of glyphosate plus $GA_{3,}$ glyphosate plus IBA (70.70%) whereas, Fluazifop-butyl plus glycerin caused maximum reduction in dry weights (81.02 %) and Fluazifop-butyl at full rate plus glycerin (74.58 %) in the first season and second season, respectively. Further research on the effects of the best herbicides selectivity is needs with combination of additives, mechanical, and agricultural methods on *I. cylindrica* control under the field conditions.

**Keywords:**
Invasive weed species, *I. cylindrica*, Glyphosate, Fluazifop-butyl, additives, management.

# INTRODUCTION

Cogongrass, *Imperata cylindrica* (L.) is a perennial grass species found throughout the tropical and subtropical regions of the world (Anis *et al.*, 2020). It produces extensive rhizomes which allow it to spread and dominate a wide range of disturbed sites (Holm *et al.*, 1977). It is a noxious weed widespread in most tropical zones of the world (Chikoye *et al*., 2002). *I. cylindrica* was become one of the most damaging invasive C4 grass, invaders, with high drought tolerance, adaptations to high temperatures, and high water use efficiency, could responds to soil water and nutrient stress (Zhang *et al*., 2021). Cogongrass has a light compensation point of 32 to 35 mol. $m^{-2}$ $s^{-1}$(approximately 2% full sunlight) indicating the ability to survive as an understory species. This would explain its ability to both rapidly invade deforested areas and persist in plantation crops (Ramsey *et al*., 2003). Cogongrass first-year seed germination from populations was over 95%. Seedlings tend to emerge in groups and seeds require light for germination. Cogongrass poses the most serious threat to native ecosystems (Matlack, 2002). Cogongrass is a problematic weed causes significant losses in cultivated and non-cultivated areas, and is difficult to control (Mohamad *et al*., 2012). Cogongrass is a better competitor for phosphorus than native pine-savanna species, legume species are frequently displaced through this competitive mechanism (Brewer and Cralle, 2003). *I. cylindrica* is difficult to control in the tropics regions (Vissoh *et al*., 2008). Cogongrass is grass has natural potentialities for difficult the eradication for increased resistance (Santiago1976). It difficult weeds to control in many crops grown and one of the most common a noxious weed in West Africa (Chikoye and Ekeleme, 2000). It is a noxious weed in Asia which relates to its control by many herbicides and also emphasis on the additives activity of to improve glyphosate (Terry *et al.*, 1997). Repeated control herbicide treatments are effective for *I. cylindrica* suppression (Enloe *et al*., 2013). Therefore, developing an effective method to control this weed has become worthwhile practice and a significant (Huang *et al*., 2012). Integrated management approach using all available methods is necessary to control *I. cylindrica* (Jose *et al*., 2002). It is a noxious weed in Asia which relates to its control by many herbicides and also emphasis on the additives activity of to improve glyphosate (Terry *et al*., 1997). *I. cylindrica* is a weed is hardy and difficult to control by traditional methods such as hoeing or tillage. Possibility of using an important legume to control the important tropical weed *I. cylindrical* (Premalal *et al*., 1995). So that chemical methods are generally used, but mechanical control is being more sustainable practices (Gbehounou *et al*., 2000), shade-based control (Macdicken *et al*., 1996). Raising the efficiency of the chemical methods could be possible by using additives to spray tank solutions (Balah, 2013). Compared the effects of glyphosate and imazapyr, mixed with and without four adjuvants, for *I. cylindrica* control. The lack of improved herbicide efficacy when adjuvants were mixed together indicates that they should be selected on a cost basis, and not combined when mixed with imazapyr. Adjuvants included an organosilicone surfactant, methylated seed oil, seaweed extract/foliar fertilizer, and a sticker/protectant adjuvant. Cogongrass cover, foliar biomass, and rhizome biomass were selectively sampled at 12, 20, and 24 months after treatment (MAT) (Ramsey et al., 2012). Nonionic surfactant followed with Arabic gum and petroleum oil has been found to promote the performance of herbicide than methylated vegetable oil (Balah, 2010). The maximum reduction was recorded from binary mixture of glyphosate with glycerin and followed by the surfactants monoleate, dioleate and sticking agents such as glue, urea, whereas the crop seed oil and petroleum oil came in the second category in relation to glyphosate efficiency against weeds as indicated by weed seedling parameters (Balah et al., 2006). Good control can be achieved strategies by integrating cultural, mechanical, and chemical methods sustainable, integrated, biological control and revegetation practices long term and require careful planning to achieve the desired outcome. Currently, the problem related to its invasiveness negatively affects all production plantation, and forest crops. Its mode of reproduction fosters its extensive growth and very persistent nature because of its high competitive ability in a wide range of habitats (Rusdy, 2020). *I. cylindrica* is one of the worst weeds in Egypt that cause a significant loss in crop productivity, as well as many indirect environmental and economic problems. While, control methods are not effective enough and highly costing. Therefore, this work aims to evaluate the efficacy of fluazifop-p-butyl and glyphosate alone and in combination with some additives to improve the efficiency of these herbicides against *I. cylindrica* under desert conditions.

## MATERIAL AND METHODS

Two field experiments under field and greenhouse conditions were conducted in Toshka Research Station, Desert Research Center, Egypt during 2018/2019 and 2019/2020 summer seasons (July and August) to evaluate the efficacy of fluazifop-p-butyl (inhibiting lipid synthesis) and glyphosate (disrupts the shikimic acid pathway through inhibition of the enzyme 5-enolpyruvylshikimate-3-phosphate (EPSP) synthase) and some additives against *I. cylindrica*.

**Chemicals**

1. ***Herbicides***

The tested herbicides chosen according to (Coomans, 1976 and Soerjani, 1970) that recommended to control of *I. cylindrica*.

2. ***Additives***

The trade names, chemical structures, classification and suppliers are listed in table (2).

**Evaluation of spray tank physical and chemical properties (Herbicides- adjuvants mixtures**

1. ***pH values***

The spray solutions after mixing herbicide with additive were shaken well to make homogeneous solution. Then, pH meter used to measure the pH values.

2. ***Conductivity (EC) and total dissolved salts (TDS)***

The spray tank solutions after mixing herbicide with additive were shaken well to make homogeneous solutions, and then a constant volume was used to measure the conductivity and EC in m mhos units while TDS was determined in g/l units.

3. ***Surface tension***

The spray tank solutions of Herbicides- additive mixture were shaken again to measure the surface tension, where dyne/cm are the unit of surface tension measurement.

**Evaluation of herbicides with additives on *I cylindrica* growth under greenhouse**

The investigation was conducted to evaluate the efficacy of two herbicides, namely fluazifop-butyl and glyphosate alone and with some additives against *I. cylindrica* in the greenhouse at Desert Research center. *I. cylindrica* roots and rhizomes were harvested from a natural infestation in Toshka region, Egypt, five pieces of rhizomes (3-5cm) were placed in each plastic pots. Pots were arranged in a complete randomized-block design. Pots were gently and regularly irrigated in 3 day intervals with suitable amounts of water until 5 to 7 leaves stage approximately 4-6 weeks. Glyphosate and fluazifop-butyl at 2000 & 4000 ppm) with additives at 0.4% treated on *I. cylindrica*. Controls were made with 100 ml water without herbicides. The selected herbicides were sprayed on broadcast applications by knapsack sprayer at water spray volume of 125 L water. The comparison was done with untreated control and herbicides at the recommended dose without additives. Three replicates per each concentration were used. After six weeks from treatment, the rhizomes collected and re-sprout in other pots to measure the efficiency of herbicides.

**Evaluation of herbicides with adjuvants on *I. cylindrica* growth under field condition**

Field experiments were conducted in Toshka Research Station, Desert Research center, Egypt. The experiments were established on a sandy soil infested with *I. cylindrica* during the two successive seasons, 2018/2019 and 2019/2020 to evaluate tested herbicides. The treatments consisted of glyphosate herbicides applied at the recommended rate (2500 ml and 1500 ml of the aforementioned herbicides, respectively / 125 L. water), fluazifop-butyl applied at full recommended rate and three-quarters rate (1875 and 1125 ml) respectively, and half rate recommended (750 ml and 1250 ml) of the aforementioned herbicides respectively, using Knapsack hand (TKI) spray fitted with one nozzle was used without or with adjuvants at 0.4% Table (2). These amounts were diluted with 125 litters of water per Fadden. The control plots were sprayed with water and were sprayed to the plants at their

5-7 leaves stage.. The comparison was done with untreated control and herbicides at the recommended dose without additives. Three replicates per each concentration were used. After three weeks from treatment fresh and dry weight were recorded. Whereas, the experiments repeated more than one time. The field weeds were recorded using a (0.5 $m^2$) quadrat randomly in each sampling plot. Five samples were randomly with rhizomes in 15cm depth the topsoil to weighed (fresh weight and dry weight after treatment).

**Statistical Analyses**

Treatments were arranged in a completely randomized block design in Toshka region, and Toshka Research station, Desert Research Center, Egypt. Data were subject to analysis of Variance to test treatment means for *I. cylindrica* fresh and dry weight after treatment according to (Snedecor and Cochran, 1990) and treatment means were compared by using Least Significant Difference (LSD) and Duncan probability.

# RESULTS AND DISCUSSION

**Physical and chemical properties herbicides-adjuvants mixtures of spray tank of application at the field.**

Data in table (3) indicate the differences of tank mixtures physico- chemical properties of water in field than greenhouse while glyphosate used by 3/4 full and half rates (1875 ml/125 L/fed. and 1250 ml/125L/fed.), respectively compared with full rate (2500 ml/125 L/fed.). It is clearly evident in the binary mixtures, to notice that, the tested glyphosate-additives solution is characterized with acidic properties. The highest pH was recorded with glyphosate- gibberellic acid (GA3) mixture at full rate, 3/4 full rate and half rate by 5.2, 5.3 and 5.4 respectively, while glyphosate alone at full rate, 3/4 full rate and half rate was 5.0, 4.9, 5.0, respectively. As for the properties of glyphosate- additives data in the same table (3) indicate the important role of chemical recipes of each mixture on its physico-chemical properties. The highest value of electric conductivity (EC) was recorded with glyphosate-sulfuric acid ($H_2SO_4$) mixture (33700 µmhos /cm), (38900 Ms/cm) and (41800 µmhos /cm), while the EC values of the other mixtures were (5060 - 7150 µmhos /cm), (3930 - 6650 µmhos /cm), and (2582 - 4620 µmhos /cm), compared to (5870 - 4280 -3400 µmhos /cm), glyphosate alone at (full, 3/4full, and half) rates of glyphosate, respectively and control (2009 µmhos /cm) in the same table. As for total dissolved salts (TDS), the highest values were recorded with glyphosate- sulfuric acid mixture at full, 3/4full, and half rates by 21568 mg/l, 24896 mg/l, and 26752 mg/l respectively. The full, 3/4 full and half rates of glyphosate alone achieved total dissolved salts by 3756.8, 2739.2, and 2176 mg/l respectively. Data that surface tension of glyphosate alone at full, 3/4 full and half rates was 63 dyn/cm, 58.5 dyn/cm and 54 dyn/cm respectively. The lowest surface tension values were recorded with glyphosate- glycerin at 0.4%-mixture at full, 3/4 full and half rates reached 40.5, 45 dyn/cm and 45 dyn/cm respectively.

Under field conditions, data in table (4) indicate the differences of physico- chemical properties than greenhouse while Fluazifop-butyl used full and by 3/4 rates (1125ml/125 L. water/fed. and 750 ml/125 L. water/fed.), respectively compared with full rate (1500 ml/125lit/fed). It is clearly evident to notice that the tested Fluazifop-butyl -adjuvant are characterized with acidic properties. The highest PH was recorded with Fluazifop-butyl - gibberellic acid (GA3) mixture at full rate, 3/4 rate, and 1/2 rate were pH values by 6.2, 6.4 and 6.4 respectively. While, Fluazifop-butyl alone, full, 3/4, and 1/2 rates showed pH by 4.8, 3.7and 4.9, respectively in the same table. As for the properties of Fluazifop-butyl - additives binary mixtures, the highest value of electric conductivity (EC) was recorded with Fluazifop-butyl - Si Si-6 (Potassium sulphonate) mixture full, 3/4 rate and by 1/2 rates was 123300, 163800 and 172900 µmhos /cm respectively, while Fluazifop-butyl alone at full rate - 3/4 rate and half rates being EC by 23510, 21110 and 13420µmhos /cm in the same table. As for total dissolved salts (TDS), data indicate that the highest values were recorded with Fluazifop-butyl - Potassium sulphonate (Si Si-6) mixture at full rate - ¾ rate and 1/2 rates by 78912, 104832 and110656 mg/l, respectively. The Fluazifop-butyl alone showing TDS' s reached 15046.4, 13510.4 and 8588.8.4mg/l respectively. Data in table (4) indicate surface tension value was 63 dyn/cm, 58.5 dyn/cm and 58.5 dyn/cm of this property with Fluazifop-butyl alone at full, ¾ and 1/2 rates, respectively. Data indicate that the less values were recorded with Fluazifop-butyl – glycerin 0.4%- mixture at full, ¾ and 1/2 rates by 49.5, 49.5 and 45 dyn/cm, respectively. This result is also in agreement with Furmidge (1962), who stated that wetting agents decreased the surface tension of the spray solution and increased the wettability, spreading and depositing on treated surfaces with increased herbicidal efficiency. Adding glycerin as nonionic surfactant to glyphosate in the spray tank increased glyphosate (IPA) biological performance against intractable weeds (Balah, 2011). Water in oil micro emulsions forming size droplets able to higher their herbicidal activity than essential oils alone and their formulated emulsions without change in their chemical structure (Balah, 2013).

**Evaluation of the tested herbicides- additives under greenhouse conditions**

Concerning the effects of Glyphosate at and Fluazifop-butyl at 2000 ppm-4000 ppm concentration in with additives (0.4%) in binary mixtures against *I. cylindrica*, the re-sprout was taken to measure its efficacy under greenhouse condition. Table (4) indicate the efficacy of glyphosate at 2000 ppm after three weeks. The highest reduction in rhizomes re-sprout was recorded from glyphosate plus gibberellic acid (GA3) mixture by (71.43%), followed by glyphosate plus glycerin mixture (70.43%), while glyphosate alone (28.57 %) respectively. As for glyphosate at 4000 ppm, it achieved reduction by, (85.71%) glyphosate plus GA3, and (42.86%) glyphosate alone respectively.

Data in Table (4) indicated the effect of Fluazifop-butyl at 2000-4000 ppm, while the additives values of (0.4%), in *I. cylindrica* re-sprout. As for Fluazifop-butyl at 2000 ppm, the highest reduction in rhizomes re-sprout was recorded by (64.29%) Fluazifop-butyl-glycerin mixture and (28.57 %) Fluazifop-butyl alone, respectively. As for Fluazifop-butyl at 4000 ppm, the reductions in rhizomes re-sprout showed (71.43%) Fluazifop-butyl plus glycerin ad (50%) Fluazifop-butyl alone, respectively. These results are in agreement with Chikoye et al. (2002); where farmers have to control weed severally because of continuous rhizome growth. Binary mixture of glyphosate with glycerin resulted s high reduction in weed growth parameters (Balah et al., 2006).

**Evaluation of the tested herbicides- additives mixtures under field conditions**

***1. Glyphosate***

Results in Table (5) indicate the efficacy of glyphosate under the infested field with *I. cylindrica* after three weeks from treatment, it showed reduction percentage by (77.27% - 55.64%) at full rate, (77.24% -57.61%) at 3/4 rate, and (79.82% - 61.98%) ½ rate, respectively in the first and second season respectively. In the first season, the higher reduction was recorded with glyphosate plus IBA at the full rate by (86.45%), glyphosate plus $GA_3$ at 3/4 rate (87.77%) and glyphosate plus with GA at ½rate (92.22%), respectively. While the other mixtures, showed reduction reached (77.84- 86.45%) ¾ rate, (79.65- 85.78%) ½ rate and (81.03- 91.95%) full rate of glyphosate alone, respectively. The second season, the higher reduction was recorded by (70.20%) glyphosate plus $GA_3$ at ½rate, (71.65%) ¾ rate, (81.67%) full rate respectively. While the other mixtures showed reduction by (55.26- 69.30%) ½ rate, (57.33- 67.05%) ¾ rate and (61.72- 81.05%) full rate of glyphosate alone respectively.

As for dry weights of the *I. cylindrica* weed, glyphosate alone coursed a reduction percentage by (55.64% - 49.58%) full rate, (57.61% -47.03%) 3/4 rate, and (61.98% - 51.10%) ½ half rate in first season and second season, respectively. The higher reductions were recorded with glyphosate at the full rate plus $GA_3$ (70.20%) and 3/4 rate of glyphosate plus $GA_3$ (71.65%) in first season. The followed reductions were recorded with glyphosate at ½ rate of glyphosate plus $GA_3$ (81.67%) in first season. While the other mixtures showed reduction reached (55.26- 69.30%) full rate, (57.33-67.05%) ¾ rate and (58.91- 81.05%) with ½rate of glyphosate in first season respectively. In the second season, the higher reduction was recorded on shoot dry from glyphosate plus $GA_3$ (60.64%) full rate, and glyphosate plus $GA_3$ (61.26%) ¾ rate, but in second season glyphosate plus IBA was (70.70%) respectively. Other mixtures, showed reductions ranged (47.49- 60.48%) full rate, (47.92- 55.67%) ¾ rate and (46.96- 70.62%) ½rate of glyphosate alone, respectively. Our results are agreement with Balah (2011) which reported that, the improvement in glyphosate bio efficacy depends on additive types and weed species.

**Table (1) Profile of herbicides used in the study. (Syngenta UK Ltd, Fusilade product label).**

| Common name | Trade name | Conc. & formulation | Used rate (ml/125 liters) water | EPA toxicity class | Herbicides Types |
|---|---|---|---|---|---|
| Fluazifop-butyl | Fusilade max | 12.5 %EC | 1500 ml | IV | Selective |
| Glyphosate | Round up star | 44.1 %SL | 2500 ml | II | Non-selective |

**Table 2. Profile of tested additives used in the study.**

| Additives | used rate % | classification and suppliers |
|---|---|---|
| **SiSi-6** | 0.4 | Potassium sulphonate 10%SL. It is anionic surfactant prepared by dr. Ahmed El-Sisi (Agriculture Research Center) used as wetting and spreading agent. |
| **Arex-Do** | 0.4 | It is nonionic surfactant, produced by Alex Co., Alexandria, used as wetting and spreading agent. |
| **Glycerin** | 0.4 | Non-ionic and spreading agent (El-Gomhoria Medical company). |
| **CMC** | 0.4 | Carboxyl methyl cellulose sodium salt, (El-Gomhoria company Medical and chemicals Cairo), used for increasing viscosity of spreading agent |
| **Mineral oil (KZ)** | 0.4 | KZ oil (Kafr El-Zayat company). |
| **Mineral oil (CAPL2)** | 0.4 | Prepared as emulsifiable concentrate 96.6% and used as lipophilic material. |
| **Jojoba oil** | 0.4 | Deposition aids (Local production) |
| **Camphor oil** | 0.4 | Deposition aids (Local production) |
| **Sulfuric acid98%** | 0.4 | (El-Nasr Pharmaceutical Chemicals Co.) |
| **Acetic acid96%** | 0.4 | (El-Nasr Pharmaceutical Chemicals Co.) |
| **Gibberellins (Berlex)** | 0.4 | GA3 (gibberellic acid) 10%(0.2 gm/0.5l= 40 ppm |
| **Indole butyric acid (I.B.A)** | 0.4 | C12H12NO2K 98% Country of manufacture: - China. (Exclusive distribution: - Green Egypt Co.) |

**Table (3) Physical and chemical properties of glyphosate, Fusilade and its mixtures with adjuvants application at the field.**

| Rate of application at the field | Treatments | pH | EC µmhos /cm | TDS mg/l | Surface tension dyn/cm | Rate of application at the field | PH | EC µmhos | TDS mg/l | Surface tension |
|---|---|---|---|---|---|---|---|---|---|---|
| | Control | 5.8 | 2009 | 1285.76 | 72 | | 5.8 | 2009 | 1285.76 | 72 |
| Glyphosate (2500ml/ 125 Liter water) | N0 add. alone | 5 | 5870 | 3756.8 | 63 | Fluazifop (1500 ml/ 125 Liter water) | 4.8 | 23510 | 15046.4 | 63 |
| | GA (0.4%) | 5.2 | 7150 | 4576 | 49.5 | | 6.2 | 1940 | 1241.6 | 54 |
| | IBA (0.4%) | 4.9 | 5790 | 3705.6 | 58.5 | | 3.3 | 36100 | 23104 | 58.5 |
| | Arex-D (0.4%) | 4.9 | 5060 | 3238.4 | 58.5 | | 4.1 | 32800 | 20992 | 54 |
| | Si Si-6 (0.4%) | 5.0 | 5730 | 3667.2 | 41.5 | | 5.0 | 123300 | 78912 | 54 |
| | Jojoba oil (0.4%) | 5.0 | 5870 | 3756.8 | 54 | | 3.6 | 23550 | 15072 | 54 |
| | Caphor oil (0.4%) | 5.0 | 5730 | 3667.2 | 54 | | 4.2 | 8490 | 5433.6 | 63 |
| | Capil 2 (0.4%) | 5.0 | 5800 | 3712 | 58.5 | | 3.2 | 18850 | 12064 | 58.5 |
| | KZ oil (0.4%) | 4.9 | 5710 | 3654.4 | 45 | | 4.5 | 27000 | 17280 | 58.5 |
| | H2So4 (0.4%) | 1.9 | 33700 | 21568 | 63 | | 2.2 | 51500 | 32960 | 54 |
| | CH3CooH (0.4%) | 3.8 | 5840 | 3737.6 | 54 | | 3.0 | 516 | 330.24 | 63 |
| | CMC (0.4%) | 5.0 | 6760 | 4326.4 | 63 | | 4.3 | 498 | 318.72 | 58.5 |
| | Glycerin (0.4%) | 5.0 | 5610 | 3590.4 | 40.5 | | 3.5 | 30900 | 19776 | 49.5 |
| Glyphosate (1875 ml/ 125 Liter water | N0 add. alone | 4.9 | 4280 | 2739.2 | 58.5 | Fluazifop (1125 ml/ 125 Liter water) | 3.7 | 21110 | 13510.4 | 58.5 |
| | GA(0.4%) | 5.3 | 6650 | 4256 | 49.5 | | 6.4 | 1399 | 895.36 | 54 |
| | IBA(0.4%) | 4.8 | 4520 | 2892.8 | 49.5 | | 4.1 | 38200 | 24448 | 54 |
| | Arex-D(0.4%) | 4.8 | 4600 | 2944 | 54 | | 3.9 | 30400 | 19456 | 58.5 |
| | Si Si-6(0.4%) | 4.9 | 4870 | 3116.8 | 45.5 | | 5.1 | 163800 | 104832 | 45 |
| | Jojoba oil(0.4%) | 5.0 | 4630 | 2963.2 | 58.5 | | 4.2 | 21570 | 13804.8 | 54 |
| | Caphor oil(0.4%) | 5.0 | 4620 | 2956.8 | 54 | | 5.1 | 9850 | 6304 | 54 |
| | Capil 2(0.4%) | 5.0 | 3930 | 2515.2 | 54 | | 4.4 | 20850 | 13344 | 45 |
| | KZ oil(0.4%) | 4.9 | 4350 | 2784 | 49.5 | | 4.6 | 22220 | 14220.8 | 58.5 |
| | H2So4(0.4%) | 2.0 | 38900 | 24896 | 58.5 | | 2.2 | 51100 | 32704 | 54 |
| | CH3CooH(0.4%) | 3.8 | 4520 | 2892.8 | 54 | | 3.1 | 498 | 318.72 | 54 |
| | CMC(0.4%) | 5.0 | 5580 | 3571.2 | 63 | | 5.4 | 905 | 579.2 | 54 |
| | Glycerin(0.4%) | 5.0 | 4570 | 2924.8 | 45 | | 4.0 | 30400 | 19456 | 49.5 |
| Glyphosate (1250ml/ 125 Liter water) | N0 add. alone | 5.0 | 3400 | 2176 | 54 | Fluazifop (750 ml/ 125 Liter water) | 4.9 | 13420 | 8588.8 | 58.5 |
| | GA(0.4%) | 5.4 | 4620 | 2956.8 | 49.5 | | 6.4 | 1460 | 934.4 | 54 |
| | IBA(0.4%) | 5.0 | 3270 | 2092.8 | 45.5 | | 3.6 | 37400 | 23936 | 58.5 |
| | Arex-D(0.4%) | 5.0 | 3260 | 2086.4 | 49.5 | | 3.1 | 27660 | 17702.4 | 58.5 |
| | Si Si-6(0.4%) | 5.1 | 3420 | 2188.8 | 45.5 | | 5.0 | 172900 | 110656 | 54 |
| | Jojoba oil(0.4%) | 5.0 | 3260 | 2086.4 | 49.5 | | 5.4 | 19100 | 12224 | 58.5 |
| | Caphor oil(0.4%) | 5.1 | 3130 | 2003.2 | 58.5 | | 3.5 | 7479 | 4786.56 | 63 |
| | Capil 2(0.4%) | 5.2 | 2808 | 1797.12 | 49.5 | | 4.1 | 14980 | 9587.2 | 54 |
| | KZ oil(0.4%) | 5.1 | 3370 | 2156.8 | 49.5 | | 3.5 | 18380 | 11763.2 | 58.5 |
| | H2So4(0.4%) | 2.0 | 41800 | 26752 | 58.5 | | 2.1 | 50900 | 32576 | 58.5 |
| | CH3CooH(0.4%) | 3.8 | 3450 | 2208 | 49.5 | | 2.6 | 420 | 268.8 | 54 |
| | CMC(0.4%) | 4.8 | 4040 | 2585.6 | 63 | | 4.8 | 1111 | 711.04 | 54 |
| | Glycerin(0.4%) | 5.1 | 2582 | 1652.48 | 45 | | 3.7 | 29300 | 18752 | 45 |

**Table (4) Effects of herbicides - additives mixtures in *I.* cylindrica rhizomes re-sprout (regrowth) after 4 weeks from treatment.**

| Concentration | Treatment | | Glyphosate | | Fluazifop-butyl | |
|---|---|---|---|---|---|---|
| | | | Regrowth (3Sample) | R% | Regrowth (3Sample) | R% |
| | Control | | $4.67^{a}$ | 0.00 | $4.67^{a}$ | 0.00 |
| Gly.Or.Flu.( 2000 ppm) | Herbicides alone | | $3.33^{b}$ | 28.57 | $3.33^{b}$ | 28.57 |
| | Herbicides. Plus (Adj. Conc. (0.4%)) mixture | GA | $1.33^{cde}$ | 71.43 | $2.33^{bcde}$ | 50.0 |
| | | IBA | $1.34^{cde}$ | 70.43 | $2.66^{bcd}$ | 42.86 |
| | | Arex-D | $2.67^{bc}$ | 42.86 | $3.00^{bc}$ | 35.71 |
| | | Si Si-6 | $1.67^{cde}$ | 64.29 | $2.92^{bc}$ | 36.71 |
| | | Jojoba oil | $2.00^{bcde}$ | 57.14 | $3.00^{bc}$ | 35.71 |
| | | Caphor oil | $2.33^{bcd}$ | 50 | $3.00^{bc}$ | 35.71 |
| | | Capel 2 | $2.67^{bc}$ | 42.86 | $3.00^{bc}$ | 35.71 |
| | | KZ Oil | $2.33^{bcd}$ | 50 | $3.00^{bc}$ | 35.71 |
| | | $H_2SO4$ | $2.67^{bc}$ | 42.86 | $3.00^{bc}$ | 35.71 |
| | | $CH_3CO$ OH | $2.67^{bc}$ | 42.86 | $3.33^{b}$ | 28.57 |
| | | CMC | $2.33^{bcd}$ | 50 | $3.33^{b}$ | 28.57 |
| | | Glycerin | $1.34^{cde}$ | 70.43 | $1.66^{de}$ | 64.29 |
| Gly.Or.Flu.(4000 ppm) | Herbicides alone | | $2.67^{bc}$ | 42.86 | $2.33^{bcde}$ | 50.00 |
| | herbicides. Plus (Adj. Conc. (0.4%)) mixture | GA | $0.67^{e}$ | 85.71 | $1.52^{de}$ | 65.29 |
| | | IBA | $1.00^{de}$ | 78.57 | $1.60^{de}$ | 64.55 |
| | | Arex-D | $2.33^{bcd}$ | 50 | $3.00^{bc}$ | 35.71 |
| | | Si Si-6 | $1.33^{cde}$ | 71.43 | $1.66^{de}$ | 64.29 |
| | | Jojoba oil | $1.67^{cde}$ | 64.29 | $1.66^{de}$ | 64.29 |
| | | Caphor oil | $2^{bcde}$ | 57.14 | $1.66^{de}$ | 64.29 |
| | | Capel 2 | $1.67^{cde}$ | 64.29 | $1.66^{de}$ | 64.29 |
| | | KZ Oil | $1.67^{cde}$ | 64.29 | $2.00^{cde}$ | 57.14 |
| | | $H_2SO4$ | $2.33^{bcd}$ | 50.00 | $2.33^{bcde}$ | 50.00 |
| | | $CH_3CO$ OH | $1.67^{cde}$ | 64.29 | $1.66^{de}$ | 64.29 |
| | | CMC | $2.33^{bcd}$ | 50.00 | $2.33^{bcde}$ | 50.00 |
| | | Glycerin | $1.32^{cde}$ | 72.43 | $1.33^{e}$ | 71.43 |
| | **F (p value)** | | **3.27(0.00)** | | **5.56(0.00)** | |

**Table (5) Effect of glyphosate and its adjuvants mixtures on shoot fresh and dry weights against *I. cylindrica* weeds under field conditions after 3 weeks of treatment.**

| Treatments | adjuvants | 1$^{st}$ season | | | | 2$^{nd}$ season | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Fresh weight | R% | Dry weight | R% | Fresh weight | R% | Dry weight | R% |
| | Control | 167.67$^{a}$ | 0.00 | 59.31$^{a}$ | 0.00 | 154.87$^{a}$ | 0.00 | 54.52$^{a}$ | 0.00 |
| Glyphosate (2500 ml/ 125 Liter water) = (full rate) | Glyphosate alone. | 38.10$^{b}$ | 77.27 | 26.31$^{bc}$ | 55.64 | 41.23$^{bc}$ | 55.64 | 27.49$^{bcdef}$ | 49.58 |
| | GA | 22.62$^{lm}$ | 86.51 | 17.67$^{kl}$ | 70.20 | 25.75$^{opqr}$ | 70.20 | 21.45$^{klmn}$ | 60.64 |
| | IBA | 22.72$^{lm}$ | 86.45 | 18.21$^{jkl}$ | 69.30 | 25.85$^{opqr}$ | 69.30 | 21.54$^{klmn}$ | 60.48 |
| | Arex-D | 28.86$^{defghij}$ | 82.79 | 21.53$^{efghij}$ | 63.70 | 32.03$^{hijklm}$ | 63.70 | 24.60$^{efghijkl}$ | 54.87 |
| | Si Si-6 | 26.87$^{fghijk}$l | 83.97 | 21.66$^{defghij}$ | 63.47 | 30.00$^{klmn}$ | 63.47 | 25.00$^{defghijk}$ | 54.15 |
| | Jojoba | 27.90$^{fghijk}$ | 83.36 | 22.48$^{defg}$ | 62.09 | 30.70$^{klmn}$ | 62.09 | 25.58$^{bcdefghij}$ | 53.08 |
| | Caphor | 28.50$^{efghijk}$ | 83.00 | 22.99$^{cdefg}$ | 61.24 | 31.38$^{jklm}$ | 61.24 | 26.02$^{bcdefghij}$ | 52.26 |
| | Capil 2 | 28.54$^{efghijk}$ | 82.97 | 21.05$^{fghijk}$ | 64.50 | 31.34$^{jklm}$ | 64.50 | 23.74$^{ghijkl}$ | 56.45 |
| | KZ | 29.03$^{defghi}$ | 82.68 | 21.66$^{defghij}$ | 63.48 | 32.16$^{hijklm}$ | 63.48 | 23.81$^{ghijkl}$ | 56.32 |
| | H2So4 | 37.16$^{b}$ | 77.84 | 26.53$^{b}$ | 55.26 | 40.29$^{bcd}$ | 55.26 | 28.63$^{bc}$ | 47.49 |
| | CH3CooH | 30.27$^{cdefgh}$ | 81.94 | 22.25$^{defghi}$ | 62.48 | 33.07$^{ghijkl}$ | 62.48 | 22.80$^{ijklm}$ | 58.17 |
| | CMC | 29.86$^{defghij}$ | 82.19 | 22.22$^{defghi}$ | 62.53 | 32.99$^{ghijkl}$ | 62.53 | 25.37$^{bcdefghij}$ | 53.45 |
| | Glyc | 23.80$^{jklm}$ | 85.81 | 19.19$^{hijkl}$ | 67.65 | 26.93$^{nopq}$ | 67.65 | 22.44$^{jklm}$ | 58.84 |
| Glyphosate (1875 ml/ 125 Liter water) = (¾ rate) | Glyphosate alone | 38.15$^{b}$ | 77.24 | 25.14$^{bcde}$ | 57.61 | 43.31$^{b}$ | 57.61 | 28.87$^{b}$ | 47.03 |
| | GA | 20.51$^{mn}$ | 87.77 | 16.8$^{1m}$ | 71.65 | 25.34$^{pqr}$ | 71.65 | 21.12$^{lmn}$ | 61.26 |
| | IBA | 23.84$^{jklm}$ | 85.78 | 19.54$^{ghijkl}$ | 67.05 | 29.00$^{lmnop}$ | 67.05 | 24.17$^{fghijk}$l | 55.67 |
| | Arex-D | 30.10$^{cdefgh}$ | 82.04 | 22.97$^{cdefg}$ | 61.26 | 35.27$^{fghij}$ | 61.26 | 26.50$^{bcdefg}$ | 51.39 |
| | Si Si-6 | 26.14$^{ghijkl}$ | 84.41 | 21.42$^{fghij}$ | 63.88 | 31.32$^{jklm}$ | 63.88 | 26.10$^{bcdefghi}$ | 52.13 |
| | Jojoba | 26.25$^{ghijkl}$ | 84.34 | 21.46$^{efghij}$ | 63.82 | 31.45$^{jklm}$ | 63.82 | 26.21$^{bcdefghi}$ | 51.93 |
| | Caphor | 26.57$^{ghijkl}$ | 84.15 | 21.77$^{defghi}$j | 63.29 | 31.73$^{ijklm}$ | 63.29 | 26.44$^{bcdefgh}$ | 51.50 |
| | Capil 2 | 27.87$^{fghijk}$ | 83.38 | 21.26$^{fghijk}$ | 64.15 | 33.03$^{ghijkl}$ | 64.15 | 25.40$^{bcdefghij}$ | 53.40 |
| | KZ | 28.64$^{efghijk}$ | 82.92 | 21.69$^{defghij}$ | 63.43 | 33.79$^{fghijk}$ | 63.43 | 24.13$^{fghijkl}$ | 55.73 |
| | H2So4 | 34.12$^{bc}$ | 79.65 | 22.70$^{defgh}$ | 61.72 | 36.94$^{defg}$ | 61.72 | 25.13$^{cdefghij}$ | 53.91 |
| | CH3CooH | 33.42$^{bcde}$ | 80.07 | 25.30$^{bcd}$ | 57.33 | 36.91$^{defg}$ | 57.33 | 28.39$^{bcd}$ | 47.92 |
| | CMC | 30.72$^{cdefg}$ | 81.67 | 23.39$^{bcdef}$ | 60.56 | 35.88$^{efghi}$ | 60.56 | 27.59$^{bcdef}$ | 49.38 |
| | Glyc | 25.46$^{hijklm}$ | 84.81 | 21.16$^{fghijk}$ | 64.33 | 30.63$^{klmn}$ | 64.33 | 25.52$^{bcdefghij}$ | 53.19 |
| Glyphosate (1250 ml/ 125 Liter water) = (½rate) | Glyphosate alone | 33.83$^{bcd}$ | 79.82 | 22.55$^{defgh}$ | 61.98 | 39.99$^{bcde}$ | 61.98 | 26.66$^{bcdefg}$ | 51.10 |
| | GA | 13.04$^{o}$ | 92.22 | 10.87$^{o}$ | 81.67 | 19.22$^{s}$ | 81.67 | 16.02$^{o}$ | 70.62 |
| | IBA | 13.49$^{o}$ | 91.95 | 11.24$^{no}$ | 81.05 | 19.66$^{s}$ | 81.05 | 15.97$^{o}$ | 70.70 |
| | Arex-D | 25.39$^{hijklm}$ | 84.86 | 19.52$^{ghijkl}$ | 67.08 | 31.56$^{ijklm}$ | 67.08 | 24.27$^{efghijkl}$ | 55.47 |
| | Si Si-6 | 16.46$^{no}$ | 90.18 | 13.71$^{mno}$ | 76.88 | 22.63$^{rs}$ | 76.88 | 18.85$^{no}$ | 65.41 |
| | Jojoba | 17.26$^{no}$ | 89.71 | 14.38$^{mn}$ | 75.76 | 23.76$^{qr}$ | 75.76 | 19.80$^{mn}$ | 63.68 |
| | Caphor | 21.76$^{lm}$ | 87.02 | 18.12$^{jkl}$ | 69.44 | 27.93$^{mnop}$ | 69.44 | 22.69$^{ijklm}$ | 58.37 |
| | Capil 2 | 23.50$^{klm}$ | 85.98 | 18.08$^{jkl}$ | 69.52 | 29.67$^{klmno}$ | 69.52 | 22.82$^{hijklm}$ | 58.13 |
| | KZ | 24.26$^{ijklm}$ | 85.53 | 18.66$^{ijkl}$ | 68.53 | 30.43$^{klmn}$ | 68.53 | 23.41$^{ghijkl}$ | 57.06 |
| | H2So4 | 31.80$^{cdef}$ | 81.03 | 22.70$^{defgh}$ | 61.72 | 37.97$^{cdef}$ | 61.72 | 27.82$^{bcde}$ | 48.97 |
| | CH3CooH | 30.44$^{cdefij}$ | 81.85 | 21.10$^{fghijk}$ | 64.42 | 36.94$^{defg}$ | 64.42 | 25.85$^{bcdefghij}$ | 52.59 |
| | CMC | 30.44$^{cdefij}$ | 81.84 | 24.37$^{bcdef}$ | 58.91 | 36.19$^{defgh}$ | 58.91 | 28.91$^{b}$ | 46.96 |
| | Glyc | 13.68$^{o}$ | 91.84 | 11.40$^{no}$ | 80.77 | 19.85$^{s}$ | 80.77 | 16.54$^{o}$ | 69.65 |
| | F (p value) | **232.47(0.00)** | | **45.79(0.00)** | | **244.50(0.00)** | | **30.96(0.00)** | |

**Table (6): Effect of Fluazifop-butyl and its mixtures on shoot fresh and dry weights in I. *cylindrica* weeds under field conditions.**

| Treatments | | 1st season | | | | 2nd season | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Fresh weight | R% | Dry weight | R% | Fresh weight | R% | Dry weight | R% |
| Control | | 167.67$^{a}$ | 0.00 | 59.31$^{a}$ | 0.00 | 154.87$^{a}$ | 0.00 | 54.52$^{a}$ | 0.00 |
| Fluazifop-butyl (1500 ml/ 125 Liter water) = (full rate) | Fluazifop alone | 69.23$^{i}$ | 58.71 | 24.20$^{j}$ | 59.20 | 73.4$^{1k}$ | 52.60 | 24.31$^{lm}$ | 55.41 |
| | GA | 35.89$^{pqr}$ | 78.59 | 12.63$^{rst}$ | 78.70 | 42.06$^{vwx}$ | 72.84 | 14.96$^{uv}$ | 72.55 |
| | IBA | 34.86$^{qr}$ | 79.21 | 12.22$^{st}$ | 79.39 | 40.35$^{wx}$ | 73.94 | 14.31$^{v}$ | 73.76 |
| | Arex-D | 46.64$^{mn}$ | 72.18 | 16.08$^{no}$ | 72.89 | 52.82$^{opqr}$ | 65.89 | 18.66$^{opqr}$ | 65.77 |
| | Si Si-6 | 35.98$^{pqr}$ | 78.54 | 12.62$^{rst}$ | 78.72 | 43.15$^{uvwx}$ | 72.13 | 14.99$^{uv}$ | 72.49 |
| | Jojoba | 37.91$^{nopqr}$ | 77.39 | 13.38$^{pqrst}$ | 77.44 | 44.08$^{tuvw}$ | 71.54 | 15.68$^{tuv}$ | 71.23 |
| | Caphor | 40.22$^{nopqr}$ | 76.01 | 14.22$^{opqrs}$ | 76.01 | 46.40$^{stuv}$ | 70.04 | 16.51stu | 69.72 |
| | Capil 2 | 40.40$^{nopqr}$ | 75.91 | 14.25$^{opqrs}$ | 75.96 | 46.57$^{stuv}$ | 69.93 | 16.45$^{stu}$ | 69.82 |
| | KZ | 41.78$^{mnopq}$ | 75.08 | 14.74$^{opqrs}$ | 75.15 | 47.95$^{rstu}$ | 69.04 | 16.88$^{rst}$ | 69.03 |
| | H2So4 | 66.78$^{ij}$ | 60.17 | 23.32$^{j}$ | 60.68 | 71.29$^{kl}$ | 53.97 | 25.09$^{l}$ | 53.97 |
| | CH3COOH | 62.99$^{ijk}$ | 62.43 | 22.18$^{jk}$ | 62.61 | 69.17$^{klm}$ | 55.34 | 24.44$^{lm}$ | 55.17 |
| | CMC | 58.85$^{jk}$ | 64.90 | 20.71$^{kl}$ | 65.07 | 65.02$^{mn}$ | 58.01 | 22.97$^{mn}$ | 57.86 |
| | Glyc | 32.10$^{r}$ | 80.85 | 11.26$^{t}$ | 81.02 | 38.95$^{x}$ | 74.85 | 13.85$^{v}$ | 74.58 |
| Fluazifop-butyl (1125ml / 125 Liter water) = (¾ rate) | Fluazifop- alone | 59.40$^{jk}$ | 64.57 | 21.06$^{kl}$ | 64.49 | 68.19$^{lm}$ | 55.97 | 23.30$^{lmn}$ | 57.26 |
| | GA | 40.65$^{nopqr}$ | 75.75 | 14.34$^{opqrs}$ | 75.82 | 51.95$^{opqr}$ | 66.45 | 18.49$^{opqr}$ | 66.09 |
| | IBA | 39.51$^{nopqr}$ | 76.43 | 13.90$^{opqrs}$ | 76.55 | 50.84$^{pqrs}$ | 67.17 | 18.02$^{pqrs}$ | 66.94 |
| | Arex-D | 45.45$^{mno}$ | 72.89 | 15.98$^{no}$ | 73.06 | 56.75$^{o}$ | 63.35 | 20.02$^{o}$ | 63.27 |
| | Si Si-6 | 41.33$^{nopq}$ | 75.35 | 14.65$^{opqrs}$ | 75.30 | 52.66$^{opqr}$ | 66.00 | 18.74$^{opqr}$ | 65.63 |
| | Jojoba | 41.55$^{mnopq}$ | 75.22 | 14.74$^{opqrs}$ | 75.14 | 52.92$^{opq}$ | 65.83 | 18.83$^{opq}$ | 65.46 |
| | Caphor | 42.64$^{mnopq}$ | 74.57 | 15.06$^{opqr}$ | 74.60 | 53.97$^{op}$ | 65.15 | 19.13$^{op}$ | 64.90 |
| | Capil 2 | 43.16$^{mnopq}$ | 74.25 | 15.19$^{opq}$ | 74.38 | 54.50$^{op}$ | 64.81 | 19.25$^{op}$ | 64.69 |
| | KZ | 44.52$^{mnop}$ | 73.44 | 15.62$^{no}$ | 73.67 | 55.89$^{o}$ | 63.91 | 19.67$^{op}$ | 63.91 |
| | H2So4 | 55.96$^{kl}$ | 66.62 | 19.21$^{lm}$ | 67.61 | 66.43$^{m}$ | 57.10 | 35.61$^{hi}$ | 34.68 |
| | CH3CooH | 55.03$^{kl}$ | 67.18 | 19.29$^{lm}$ | 67.48 | 66.36$^{m}$ | 57.15 | 29.88$^{k}$ | 45.18 |
| | CMC | 50.08l$^{m}$ | 70.13 | 17.63$^{mn}$ | 70.28 | 61.41$^{n}$ | 60.35 | 21.70$^{n}$ | 60.20 |
| | Glyc | 36.79$^{pqr}$ | 78.06 | 12.95$^{qrst}$ | 78.17 | 48.12$^{qrst}$ | 68.92 | 17.12$^{qrst}$ | 68.59 |
| Fluazifop-butyl (750 ml / 125 Liter water) = (½rate) | Fluazifop alone | 135.16$^{b}$ | 19.39 | 32.87$^{fg}$ | 44.58 | 146.27$^{b}$ | 5.55 | 51.50$^{b}$ | 5.53 |
| | GA | 85.22$^{gh}$ | 49.17 | 30.04$^{hi}$ | 49.35 | 96.34$^{i}$ | 37.79 | 34.28$^{i}$ | 37.12 |
| | IBA | 84.95$^{gh}$ | 49.33 | 30.18$^{hi}$ | 49.11 | 96.06$^{i}$ | 37.97 | 34.06$^{ij}$ | 37.53 |
| | Arex-D | 102.76$^{de}$ | 38.71 | 36.26$^{de}$ | 38.86 | 113.87$^{f}$ | 26.47 | 40.23$^{e}$ | 26.20 |
| | Si Si-6 | 90.41$^{fg}$ | 46.08 | 32.02$^{gh}$ | 46.00 | 101.56$^{h}$ | 34.42 | 36.14$^{h}$ | 33.71 |
| | Jojoba | 95.19$^{ef}$ | 43.23 | 33.59$^{fg}$ | 43.36 | 106.31$^{g}$ | 31.36 | 37.82$^{g}$ | 30.62 |
| | Caphor | 97.02$^{ef}$ | 42.13 | 34.32$^{ef}$ | 42.14 | 108.14$^{g}$ | 30.17 | 38.34$^{fg}$ | 29.66 |
| | Capil 2 | 98.23$^{ef}$ | 41.41 | 34.95$^{ef}$ | 41.07 | 109.35$^{g}$ | 29.39 | 38.63$^{efg}$ | 29.13 |
| | KZ | 102.68$^{de}$ | 38.76 | 36.27$^{de}$ | 38.84 | 113.79$^{f}$ | 26.52 | 40.06$^{f}$ | 26.52 |
| | H2So4 | 120.26$^{c}$ | 28.27 | 42.34$^{c}$ | 28.61 | 131.39$^{f}$ | 15.16 | 46.33$^{c}$ | 15.01 |
| | CH3CooH | 130.55$^{b}$ | 22.14 | 46.23$^{b}$ | 22.05 | 141.67$^{c}$ | 8.52 | 49.94$^{b}$ | 8.40 |
| | CMC | 108.29$^{d}$ | 35.41 | 38.12$^{d}$ | 35.72 | 119.40$^{e}$ | 22.90 | 42.18$^{d}$ | 22.62 |
| | Glyc | 80.26$^{h}$ | 52.13 | 28.56$^{i}$ | 51.85 | 91.37$^{j}$ | 41.00 | 32.51$^{j}$ | 40.36 |
| | F (p value) | 160.88(0.00) | | 229.18(0.00) | | 462.90(0.00) | | 391.97(0.00) | |

### 2. *Fluazifop-butyl*

Results in Table (6) indicate that, the effect of Fluazifop-butyl under the infested field with *I. cylindrica* shoot fresh and dry weights after three weeks from treatment, while their concentration played important role in this respect. As for shoot fresh weights, Fluazifop-butyl recorded a reduction percentage reached (58.71% -52.60%) with full rate, (64.57% -55.97%) with ¾ rate, and (19.39% - 5.55%) with ½rate, respectively in the first season and second season respectively. The higher reductions were recorded with Fluazifop-butyl at full rate plus glycerin reached (80.85%) in first season, while the other mixtures showed reduction by (60.17 - 79.21%) full rate, (66.62-76.43%) ¾rate and (22.14 - 49.33%) ½rate of Fluazifop-butyl, respectively in first season. In second season, the higher reductions were recorded from Fluazifop-butyl at full rate plus glycerin by (74.85%) as compared with the control. While the other mixtures decreased fresh weights by (53.97-73.94%) full rate, (57.10 - 67.17%) ¾ rate and (8.52- 37.97%) ½ rate of Fluazifop-butyl respectively.

As for dry weights of the *I. cylindrica* weed after three weeks' treatment, Fluazifop-butyl alone and its mixtures caused reduction percentage by (59.20% - 55.41%) full rate, (64.49% -57.26%) ¾ rate, and (44.58% - 5.53%) ½ rate in first and second seasons respectively. In the first season, the reduction in shoot dry weights was recorded with mixtures of Fluazifop-butyl plus glycerin at full rate by (81.02 %) as compared with the control. While the other mixtures displayed reduction reached (60.68- 78.70%) full rate, (67.48-76.55%), ¾ rate, and (22.05- 49.35%) ½ rate of Fluazifop-butyl in first season respectively. In second season, the higher reduction in shoot dry weights were recorded from Fluazifop-butyl at full rate plus glycerin (74.58 %) as compared with the control. the other mixtures exposed reduction reached (53.97- 73.76%) full rate, (34.68- 66.94%), ¾ rate, and (8.40 - 37.12%) ½ rate of Fluazifop-butyl respectively.

## CONCLUSION

*I. cylindrical* is an intractable perennial weed to control associated with a high degree of risks, the control chemical methods by glyphosate and Fluazifop-butyl in the presence of additives have remarkable role in decreasing their invasion. Therefore, the study was optimizing these herbicides against *I. cylindrica* using combination with and additives and other culture methods. Thus, the tested combinations are very helpful to establish effective to *I. cylindrica* while, the additives resulted a marked change in different physicochemical properties, but at various levels depending on the type of additive. This result is also in agreement with (Dalziel and Hutchinson, 1937, Sukartaatmadja and Siregar. 1971) it may take up to 8-10 years for the weed to die out and be replaced by natural forest. Fluazifop-butyl and glycerin to control *I. cylindrica* and transformed it to be a good way control. Balah *et al.,* (2012) when tested glyphosate treatments did not show any significant effect on soil microorganisms. These results are also in agreement with Ramsey *et al.*, (2012). A complete crop failure when crops are grown in slashed plots without additional weeding Chikoye *et al.*, 2001. When they were herbicide efficacy adjuvants mixed together should be selected on a cost basis, and not combined (Feuillette *et al.*, 1994). This study highlighted the possibility of additives with glyphosate and fusilade herbicides to well control of *I. cylindrica*. Therefore, an important role appeared from the implication of this study to prevent *I. cylindrica* weed from spreading and invaded new regions

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## الملخص العربي

**تعظيم المكافحة الكيميائية لحشائش الحلفا (امبراتا سيلندريكيا) باستخدام مبيدات فلوازيفوب - بوتيل والجليفوسات مع بعض الموادالإضافية**

**محمد عبد الوهاب خضري1، أحمد أحمد سلام2، محمد عبد العزيز بلح1**

**1 قسم وقاية النبات، مركز بحوث الصحراء، مصر**

**2 قسم وقاية النبات، كلية الزراعة، جامعة سوهاج، مصر**

تعتبر الحلفا من الحشائش المعمرة التي تغزو المناطق الاستوائية وشبه الاستوائية في جميع أنحاء العالم مسببة العديد من المشاكل البيئية والاقتصادية. لذلك تم إجراء تجربتين ميدانيتين في محطة بحوث توشكى - مركز بحوث الصحراء - مصر خلال موسمي (2019/2018 - 2020/2019 ) لتقييم فعالية مبيدات فلوازيفوب-بيوتيل والجليفوسات مع بعض الموادالإضافية ضد هذه الحشائش. أوضحت النتائج أن النسبة المئوية لإعادة نمو ريزومات الحلفا عند تطبيق المبيدات بتركيز 200، 400 جزء في المليون منفردة او مع اضافة المواد الاضافية كانت للجليفوسات مع حمض الجبريليك هي (71.43٪)، (85.71٪)، يليه الجليفوسات مع الجلسرين (70.43 و72.43٪) بينما كانت للجليفوسات بمفردة (28.57 و42.86٪) على التوالي مقارنة مع بالكنترول. في ظل الظروف الحقلية، أظهرت النتائج أن أعلي نسبة خفض في الأوزان الجافة كانت (81.67٪) مع الجليفوسات بمعدل نصف التركيز الموصي به مع حمض الجبريليك، والجليفوسات مع IBA كانت (70.70)% بينما أحدث فلوازيفوب-بيوتيل مع الجلسرين انخفاض في الوزن الجاف (81.02٪) وفلوازيفوب بوتيل بالمعدل الموصي به مع الجلسرين كانت (74.58٪). هناك حاجة إلى مزيد من البحث حول أفضل التأثيرات لمبيدات الحشائش بعد خلطها مع المواد الاضافية للتحكم في *مكافحة حشائش الحلفا*.