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Report on resistance of *Portulaca oleracea* to glyphosate application

K KalaichelviDOI: <https://doi.org/10.22271/chemi.2020.v8.i4z.9969>**Abstract**

During 2008, a confined field experiment was conducted on "Evaluation of glyphosate resistant Bt maize hybrids". In this experiment, 900, 1800 and 3600 g ae of glyphosate was tried for standardizing the dose of glyphosate for glyphosate resistant Bt corn hybrids. We have observed that *Portulaca oleracea* was not killed with all the doses of glyphosate application and was reported earlier. To confirm this, a mini field experiment has been conducted during 2014 to study that is there any resistant mechanism with *Portulaca oleracea* against glyphosate. *Portulaca oleracea* seeds have been collected and sown in 12 microplots with a dimension of 1m x 1m and allowed to grow. Glyphosate has been applied with sub optimal (5ml/litre), optimal (10ml/litre), and higher dose (15 ml/litre) along with ammonium sulphate (2%) as an adjuvant. Drying symptom with glyphosate application at 10 ml and 15 ml was observed on 3 DAHS whereas no drying symptom was observed in *Portulaca oleracea* weeds which were applied with glyphosate at 5 ml/litre and this might be due to sub – optimal dose of glyphosate application. In glyphosate application of 10 ml and 15 ml/litre; Leaf alone showed drying symptom and the stem remains healthy pink and also glyphosate has not been translocated to the root portion of the *Portulaca oleracea* as it showed healthy root system. Rainfall was received on 5DAHS; by utilizing the moisture; regeneration was observed in glyphosate applied plots. This showed that moisture would facilitate for the regeneration or regrowth of the *Portulaca oleracea* and might be happened due to the poor translocation of the herbicides. There was no complete control of *Portulaca* with optimal and high dose of glyphosate application on 10 DAHS. Hence, after 30 DAHS a weed count was taken and it was showed that only 30% population was controlled with sub – optimal dose of glyphosate application (5ml/litre); 49% and 60% control with glyphosate application at recommended (10ml/litre) and 15ml/litre respectively.

Keywords: *Portulca oleracea*, resistance, glyphosate**Introduction**

Purslane (*Portulaca oleracea* L.; Portulacaceae) is an annual fleshy weed, most commonly found in waste and barren land. It is well adapted to warm climate, and possess C4 type of photosynthesis (Rasheed *et al.*, 2004) [8]. The characteristic weedy nature of *P. oleracea* is attributed due to its ability to produce as many as 10000 seeds which may be dispersed by animals, humans and birds (Kiyoko and Cavers, 1980) [4]. Naturally, the plant is mainly propagated through seeds but it can also well propagate by the means of fleshy stem fragments. *P. oleracea* has been reported to be salt tolerant as well as drought tolerant which add to their ability to thrive under water deficient and saline conditions (Yazici *et al.*, 2007; Alam *et al.*, 2014) [12, 1]. Different herbicides varies in their ability to control the same weed. Selectivity of the chemical herbicides is that the plants are able to metabolize the herbicides hence they are not affected whereas weeds are not able to metabolize the herbicides which prove to be phytotoxic. During 2008, a confined field experiment was conducted on "glyphosate resistant Bt maize hybrids". In this experiment, 900,1800 and 3600 g ae of glyphosate was used for standardizing the dose of glyphosate for glyphosate resistant Bt corn hybrids. We have observed that *Portulaca oleracea* and *Commelina benghalensis* was not killed with both the doses of glyphosate application and was reported earlier. We thought that this might be due to the required quantity of herbicide molecule was not received or absorbed by both the species. Another reason we suspected that since both the species are of highly succulent and waxy surface coating in leaves the applied herbicide droplets may be poorly absorbed by them. Weed Resistance is the inherited ability of a plant biotype to survive the application of a herbicide, which had originally been effective against that weed population.

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There were no early reports on poor control of glyphosate against *Portulaca oleracea*. To confirm that whether the *Portulaca* has any resistant mechanism for glyphosate application under field condition. With this hypothesis, a mini field experiment was conducted to study the control efficiency of glyphosate on *Portulaca oleracea* alone under natural condition.

Materials and Methods

A mini field experiment has been conducted during 2014 to study the is there any resistant mechanism with *Portulaca oleracea* against glyphosate application. *Potulaca oleracea* seeds have been collected and sown in 12 microplots with a dimension of 1m x 1m and allowed to grow. Glyphosate has been applied using battery operated hand sprayer with sub optimal (5ml/litre), optimal (10ml/litre), and higher dose (15 ml/litre) along with ammonium sulphate (2%) as an adjuvant on 28.5.2014. Regenerated weeds were counted on 10 DAHS and 30 DAHS.

Results and Discussion

The results showed that drying symptom with glyphosate application at 10 ml and 15 ml was observed on 3 DAHS whereas No drying symptom was observed in *Potulaca oleracea* weeds which were applied with glyphosate at 5 ml/litre and this might be due to sub – optimal dose of glyphosate application. In glyphosate application of 10 ml and 15 ml/litre; Leaf alone showed drying symptom and the stem remains healthy pink and also glyphosate has not been translocated to the root portion of the *Portulaca oleracea* as it showed healthy root system. I have waited for the complete drying of the plants, however, on 2.6.2014 (5 days after glyphosate spraying) rainfall was received; by utilizing the moisture; regeneration was observed in glyphosate applied plots. This showed that moisture would facilitate for the regeneration or regrowth of the *Portulaca oleracea* and this might be due to the poor translocation of the herbicides as in one of the experiment we found that 15 minutes with rainfree period is sufficient for translocation of herbicides and this was confirmed with *Parthenium hysterophorus* but in this study after the 5 days of glyphosate application only rainfall was

received and *Portulaca* is regenerating and this should might be due to the poor control or activity due to poor translocation of the herbicides. There was no complete control of *Portulaca* with optimal and high dose of glyphosate application on 10 DAHS. Hence, after 30 DAHS a weed count was taken and it was showed that only 30% control with sub – optimal dose of glyphosate application (5ml/litre); 49% and 60% control with glyphosate application at recommended (10ml/litre) and high dose of glyphosate application (15ml/litre) respectively. This is also might be due to natural death also. The inefficiency of the herbicide in failing to control in 15 DAHS should be studied and the unknown physiology should be discovered. The higher content of betacyanin (0.38 ± 0.01 mg/g FW) and betaxanthin (0.20 ± 0.02 mg/g) was recorded in the plants treated with 5% 2, 4-D. and Glyphosate was reported by Laxmi *et al.*, 2018. She also concluded that herbicides 2, 4-D and Oxyfluorfen treatments caused inhibitory effect on pigments chlorophyll and betalain content and enzyme activity in both in vitro cultures and plants grown in natural conditions. Both herbicides were phytotoxic and effective for termination of growth when compared to glyphosate. The results provide evidence that *P. oleracea* has strong ability to survive in adverse conditions; resistance with glyphosate and 2, 4-D can be effective herbicide to control this weed. The mechanism of resistance in Georgia Palmer amaranth populations against glyphosate was investigated, and for the first time it was found that resistant plants have increased EPSPS gene copies (> 100 copies), which are distributed throughout the genome. The EPSPS copies are also functionally correlated to the increase in enzyme expression to resist high rates of glyphosate (Gaines *et al.*, 2010) [3]. EPSPS gene amplification as the mechanism of glyphosate resistance was also reported in Palmer amaranth populations from North Carolina (Chandi *et al.*, 2012 and Whitaker *et al.*, 2013) [2, 11], Mississippi (Ribeiro, 2011) [9] and New Mexico (Moghadham *et al.*, 2013) [6], whereas low levels of resistance to glyphosate because of reduced uptake and translocation were reported in Palmer amaranth populations from Tennessee (Steckel *et al.*, 2008) [10] and Mississippi (Nandula 2012) [7]. Vacuole deposition may also be one of the reason for glyphosate resistance.

Table 1: Efficiency of glyphosate application in controlling *Portulaca oleracea*

| Treatments | Initial <i>Portulaca</i> density | Number of weeds survived on 10 DAHS | Number of <i>Portulaca</i> (Regenerated) weed as on (30 DAHS) | Percentage of control | Observation |
|-------------|----------------------------------|-------------------------------------|---|-----------------------|---|
| 5ml/litre | 16 | 16 | 12 | 25 | No drying symptom was observed. No fatal death on 10 DAHS |
| | 30 | 30 | 26 | 13 | |
| | 32 | 32 | 19 | 40 | |
| | 33 | 33 | 20 | 39 | |
| | Mean | 28 | 28 | 20 | |
| 10 ml/litre | 26 | 26 | 12 | 54 | Drying symptom/mild was initiated on 3 DAHS. Leaf alone dried. weed was recovered from the drying symptom after receipt of rainfall on 5 DAHS (Days after herbicide spraying). (leaf alone slightly shows drying symptom stem portion is live with emerging young and fresh leaves on 10 DAHS), No fatal death on 10 DAHS |
| | 55 | 55 | 50 | 9 | |
| | 75 | 75 | 32 | 57 | |
| | 80 | 80 | 19 | 76 | |
| | Mean | 59 | 59 | 29 | |
| 15 ml/litre | 94 | 94 | 42 | 55 | Drying symptom/mild was initiated on 3 DAHS. Leaf alone dried. weed was recovered from the drying symptom after receipt of rainfall on 5 DAHS (Days after herbicide spraying). (leaf alone slightly shows drying symptom stem portion is live with emerging young and fresh leaves on 10 DAHS). No fatal death on 10 DAHS |
| | 169 | 169 | 120 | 29 | |
| | 181 | 181 | 33 | 82 | |
| | 38 | 38 | 10 | 74 | |
| | Mean | 121 | 121 | 51 | |

Conclusion

From this study it was concluded that drying symptom of *Portulaca oleracea* was observed with glyphosate application

at 10 ml and 15 ml on 3 DAHS whereas no drying symptom was observed in *Potulaca oleracea* weeds which were applied with glyphosate at 5 ml/litre and this might be due to sub –

optimal dose of glyphosate application. In glyphosate application of 10 ml and 15 ml/litre also; Leaf alone showed drying symptom and the stem remains healthy pink and also glyphosate has not been translocated to the root portion of the *Portulaca oleracea* as it showed healthy root system. Five (5) days after glyphosate spraying rainfall was received; by utilizing the moisture; regeneration was observed in glyphosate applied plots. This showed that moisture would facilitate for the regeneration or regrowth of the *Portulaca oleracea* and this might be due to the poor translocation of the herbicides. There was no complete control of *Portulaca* with optimal and high dose of glyphosate application on 10 DAHS. Hence, after 30 DAHS a weed count was taken and it was showed that control was only 30% with sub – optimal dose of glyphosate application (5ml/litre); 49% and 60% control with glyphosate application at recommended (10ml/litre) and high dose of glyphosate application (15ml/litre) respectively and may be including the natural death also. This showed that there should be an unknown resistance mechanism with *Portulaca* and is in progress of studying in the translocation of glyphosate in leaf, stem and root as on 10-15 DAHS only slight drying was observed in leaf alone.

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