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Short communication

P-637: A post emergence herbicide (Metribuzin) tolerant genotype of fieldpea (*Pisum sativum* L.)

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ABSTRACT

Development of post emergence herbicide resistant genotypes is the most potential way to increase farmer's income by controlling weeds, minimising yield losses and reducing cost of cultivation. An attempt was made to identify the genotypes with resistance to the post-emergence herbicide metribuzin in Fieldpea. Based on two years screening (2015-16 & 2016-17), a set of fifteen genotypes was made comprising of tolerant, moderately tolerant, sensitive and highly sensitive genotypes. These genotypes were examined in larger plot for resistance against popular post-emergence herbicide metribuzin 500 g a.i./ha during winter season of 2017-18. The plants were observed for herbicide phyto-toxicity on three different stages i.e. 15 days after herbicide application (DAHA), 30 DAHA and 60 DAHA. Based on scoring for the visual appearance and phyto-toxicity on plants, a genotype 'P-637' was found tolerant. This genotype has constantly registered tolerance for metribuzin 500 g a.i./ha during three years of screening. Hence, this genotype can be utilized as a potential donor in for future fieldpea breeding programme towards development of herbicide (metribuzin) tolerant varieties and in other basic studies.

Key words: Fieldpea, Metribuzin, Post–emergence herbicide, Tolerant genotypes

Weeds are highly competitive to the crops in term of nutrient, water, sunlight, space and also harbour many insect-pest and diseases, subsequently escort to severe yield reduction. Dry pea or fieldpea (*Pisum sativum L.*) is an important cool season legume crop and a rich source of protein (21.1-32.9%), carbohydrate, minerals and vitamins (Parihar *et al.* 2016). The productivity of this crop is affected by several biotic and abiotic factors, of them weeds can cause > 75 percent reduction in crop yield (Tripathi *et al.* 2001; Singh *et al*. 2016). This crop is a poor competitor of weeds owing to its slow initial growth and wider plant spacing that provide amiable environment for weeds to grow. Pre-emergence application of pendimethalin followed by manual weeding at 30-35 days after sowing (DAS) are widely practiced presently in fieldpea for controlling weeds. However, manual weeding is proving difficult because of labour scarcity at critical time of weeding and increasing cost. In addition, it is sensitive to the most of the potential post-emergence (POE) herbicides and thus, effective weed management is difficult for later flush of weed emergence. Hence, POE herbicides become important for weed management. However, no post-emergence herbicide is available as on today for controlling broad-leaved weeds like *Medicago denticulala, Vicia sativa, Convolvulus arvensis*, *Chenopodium album*, *Phalaris minor* etc. Therefore, an effective POE herbicide is of paramount importance to achieve potential yield (Nath *et al*. 2017). Herbicide tolerance cultivars may offer larger elasticity for use of POE herbicides and are urgently required by the *P. sativum* growing farmers. Quizalofop-p—ethyl, clodinafop-propagyl, imazethapyr, and imazethapyr + imazamox (ready-mix) are post-emergence herbicides used in many rainy season legume crops. Similarly, Metribuzin (4-Amino-6-tert-butyl-3-methylsufanyl-1, 2, 4-triazin-5-one) is a potential broad-spectrum herbicide used in soybean and wheat crops. It inhibits the photosystem-II pathway which exhibit adverse effect on the fully developed leaves and finally plant growth. So far, no report is available on herbicide tolerance in *P. sativum*. It is now well established that genotypes/ cultivars resistance to herbicide is the most potential and successful way to minimize losses due to weeds. Thus, the present investigation was attempted to identify the sources of resistance to the post-emergence herbicide metribuzin in *P. sativum*.

In a preliminary screening trial, total 822 fieldpea genotypes including germplasm accessions (indigenous and exotic collections) and released cultivars/advanced breeding lines were used during winter season of the 2015-16 against POE herbicide metribuzin 500 g a.i./ha in an Augmented Design at New Research Campus of the ICAR-Indian Institute of Pulses Research (26°28'N, 80°24' E), Kanpur, Uttar Pradesh, India. Metribuzin 500 g a.i./ha was applied at 25 days after sowing through manually operated knapsack sprayer fitted with flat fan nozzle (pressure: 200 kPa) using 400 litre of water/ha. The plants were scored for herbicide tolerance at 15 days after herbicide application (DAHA) on a 1–5 scale (Gaur *et al.* 2013). No weeding was done prior to or post herbicidal application. The visual observations were recorded for phyto- toxicity and its effect

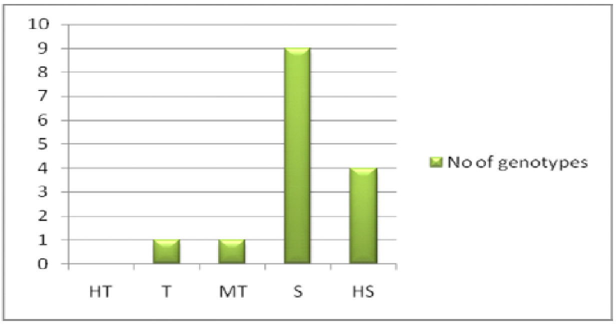

Fig. 1. Frequency distribution of 15 genotypes of fieldpea for POE herbicide (metribuzin) toxicity during winter 2017-18

on upper parts of plant i.e. leaves and stem for every individual genotype.

In the second (2016-17) year, trial was repeated with a panel of diverse 85 promising genotypes (selected on the basis of first year performance) were evaluated in order to validate the tolerance against post emergence herbicide metribuzin 500 g a.i./ha . The plants were scored for herbicide toxicity on three different stages i.e.15 days after herbicide application (DAHA) spray (DAHA), 30 DAHA and 60 DAHA and average calculated. Based on two years screening, a set of fifteen genotypes was made involving highly tolerant, tolerant, moderately tolerant, sensitive and highly sensitive genotypes. These genotypes were examined in a larger plot for resistance against popular post-emergence herbicide metribuzin 500 g a.i./ha. The plants were scored for herbicide toxicity on three different stages like 15 days after spray (DAS), 30 DAS and 60 DAS on a scale of 1–5.

The results of experiment revealed that there was a huge amount of genetic variation for tolerance against metribuzin in fieldpea. The frequency distribution based on 2016-17 observations grouped the genotypes as tolerant (1), moderately tolerant (5), susceptible (18), and highly susceptible (61) categories. In terms of phytotoxicity symptoms, metribuzin caused complete burning/death of the plants in highly susceptible genotypes with 100% mortality (phytotoxicity score 5). Further, tolerant lines had healthy plant appearance with no leaf burning/chlorosis. Metribuzin caused complete burning/death of the plants in highly susceptible genotypes with 100% mortality. These findings are in harmony with earlier reports in chickpea and peas (Gaur *et al*. 2013; Nath *et al.* 2017). Because of photosystem-II inhibition, metribuzin exhibited adverse effect on the fully developed leaves. This could be due the phenological plasticity of the pea genotypes. The susceptible and highly susceptible lines exhibited a higher magnitude of leaf burning (phyto-toxicity score >3) within a week of herbicide application (Ramakrishan *et al*. 1992; Gaur *et al*. 2013).

The visible change was observed in terms of genotypic response to herbicide toxicity after irrigation. Genotypes ET 5117 and P-1448-2 which expressed tolerance to metribuzin reverted back to susceptible or moderately group after irrigation. Importantly, genotype P-637 (phyto-toxicity score 2 during the year 2016-17 and 2017-18) consistently demonstrated tolerance for herbicide toxicity during the scoring period (stresses and unstressed condition). Based on the overall scoring, accession P-637 witnessed tolerance (phyto-toxicity score 2) and other five accessions viz., P-729, P-647, P-1075, P-2016 and P-1448-2 registered moderately tolerance reaction (phyto-toxicity score 3) against metribuzin (Table 1). The periodical variations in the genotypes were due to the residual activity

Table 1. Mean phyto-toxicity performance against post emergence herbicide (Metribuzin) in Pisum sativum during winter 2016-17

S.N.	Genotypes	Toxicity score	S.N.	Genotypes	Toxicity score	S.N.	Genotypes	Toxicity score	S.N.	Genotypes	Toxicity score
1	P-729	2.7	23	ET-5122	4.3	45	P-781	4.3	67	P-1297-22	4.0
2	P-647	2.7	24	P-1545-1	4.3	46	P-1807	5.0	68	P-815	4.3
3	P-1075	2.7	25	P-201	4.3	47	P-1034	3.7	69	P-705	4.7
4	P-1573	4.3	26	P-1297-27-1	5.0	48	P-1443-1	4.0	70	IP2K 76	4.0
5	HUDP-15	4.7	27	P-1436-5	5.0	49	P-471	4.0	71	IP2K107	3.7
6	P-637	2.0	28	IPFD 99-13	4.3	50	P-639	5.0	72	IP2K79	4.7
7	P-1297-35-1	3.3	29	P-1541-33	4.7	51	P-1375	4.7	73	IP2K 77	4.7
8	P-2016	2.7	30	P-1544-4	4.3	52	P-1448-2	2.7	74	IP2K 119	4.0
9	P-706	4.0	31	P-1545-2	5.0	53	P-1001	5.0	75	IVD 99-6	5.0
10	P-700	4.0	32	P-1456-A-3	5.0	54	P-6586	5.0	76	IVD-99-11	4.7
11	P-705	4.0	33	P-1457-1	5.0	55	P-1297-6-1	3.3	77	KSP-9	4.3
12	P-999	4.0	34	P-1547-2	4.3	56	P-1297	5.0	78	EC 329577	5.0
13	P-1042	3.7	35	P-1601	5.0	57	P-3	4.0	79	EC 389377	4.3
14	P-1046	4.0	36	P-1604	5.0	58	P-1430-2	4.3	80	EC 329568	4.0
15	P-1070	4.0	37	P-1622	5.0	59	P-600	4.0	81	EC 329576	5.0
16	P-1176-1	5.0	38	P-1621	5.0	60	P-1295	4.3	82	ET 5106	4.7
17	P-1301	3.0	39	P-91-3	5.0	61	P-1	5.0	83	ET 45190	4.3
18	P-1384-1	5.0	40	P-107	4.3	62	P-782	4.7	84	P-867	5.0
19	P-1805	4.3	41	P-107-12	4.3	63	P-744	4.3	85	IPFD 1-10	4.0
20	IVD-99-9	4.0	42	P-122-11	5.0	64	P-1808	5.0			
21	EC-382476	4.3	43	P-122-12	4.3	65	P-841	5.0			
22	ET-5117	3.0	44	P-1358	4.7	66	P-5	5.0			

of metribuzin 500 g a.i./ha. For instance, the highly susceptible genotypes showed the phytotoxicity immediately after application of herbicides. While at later stages, metribuzin caused higher phytotoxicity in some genotypes, whereas, few genotypes recovered over a period of time. None of the genotypes reacted as highly tolerant at any stage of scoring in the crop.

Similarly, during third year (2017-18) confirmation trial in larger plot, out of 15 genotypes studied, only one genotypes 'P-637' registered high level of tolerance against post emergence herbicide metribuzin 500 g a.i./ha. Another genotype P 2016 demonstrated moderately tolerance reaction and genotypes i.e. P 1436-5, P 1384-1, P 1448-2 and P 1456-A-3 reported highly susceptible resulting into complete burning of plants. These results indicated that tolerant genotypes may have the ability of quick conversation of toxic effect of metribuzin into non-toxic metabolites. These finding are in agreement to earlier reports (Gillespie *et al.* 2011). In legume crops, several herbicides including metribuzin have been recommended for weed management in Australia, Turkey, Canada (Datta *et al.* 2009). But at present, metribuzin is not recommended anywhere in *P. sativum* owing to its sensitivity to this herbicide. Therefore, herbicide tolerant cultivars of *P. sativum* are urgently needed to provide a better option for weed control over hand weeding and for broad-spectrum control of weeds through post- emergence herbicides using metribuzin.

Finally, the herbicide tolerant and moderately tolerant genotypes identified in present study would be useful in the development of herbicide tolerant cultivars. Furthermore, it would also be useful in generating basic information on inheritance, mapping and tagging of genes for herbicide (metribuzin) tolerance in *Pisum sativum*.

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