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Weeds of vineyard ecosystem and their management with selected broad spectrum herbicides

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ABSTRACT

A field experiment was conducted during 2018–19 to study weed diversity and their management by using broad spectrum herbicide. The experiment was laid out in randomized complete block design with three replications. The weed vegetation analysis was done before herbicide treatment. Herbicides evaluated were glufosinate-ammonium 13.5% SL at 375, 495 and 615 g a.i./ha, diuron 80% WP at 1600 g a.i./ha and paraquat dichloride 24% SL at 500 g a.i./ha along with hand weeding and weedy check. The weed vegetation analysis indicated that, 17 weed species were predominant which includes seven grass and eight broad leaf weed (BLW). Among the grasses, *Digitaria sanguinalis* (30.81 and 29.04%) and *Paspalidium* spp. (23.52 and 22.03) could be rated as highly predominant being much higher species density during 2018 and 2019. Among the BLW, *Ageratum conizoides* (35.6 and 36.54%) and *Parthenium hysteroporus* (24.75 and 24.19%) being predominant during 2018 and 2019. The higher control efficiency of grasses was achieved with application of glufosinate-ammonium 13.5% SL applied at 615 g a.i./ha at 30 and 45 DAT (99.51 and 98.18% and 95.31 and 98.03%, respectively during 2018 and 2019). BLW were also effectively killed by application of glufosinate-ammonium 13.5% SL at 615 g a.i./ha as evident by higher control efficiency at 30 and 45 DAT (96.30 and 94.87% and 93.97 and 94.39%, respectively during 2018 and 2019). Hence, glufosinate-ammonium13.5% SL is having greater efficacy on mixed weed population of vineyards when compared with paraquat and diuron applied at 615 g a.i./ha.

Keywords: Broad spectrum, Diversity, Glufosinate-ammonium, Grapes, Herbicide

Nandi Valley of Karnataka, India is credited with the status of Geographical Indication (GI) for cultivation of "foxy" flavour Bangalore Blue grapes genotype. Grapes (*Vitis vinifera* L.) being the profitable crop, investment are much higher on management of vineyard to achieve higher productivity. Weeds (grasses, sedges and broad leaf weed) in vineyard ecosystem limits grapes production by excreting competition for nutrients, space and water (Gaba *et al*. 2014) according to soil type, weather and crop growth stages. Ramteke *et al*. (2012) observed 378 species infesting vineyard due to availability of undisturbed vacant space between the trellied stalk. Hostetler *et al.* (2007) reported that perennial orchard maintained under intensive input management, unlimited availability water, and nutrients in vacant land usually encourages weed growth. Weeds not only compete for growth resources but also limit the quality of produce (Asaduzzaman *et al.* 2014). Hence, effective and timely management of weeds is imperative management practice in grapes.

Among the weed management practices, usage of herbicides is increased in intensified viticulture (Zaller *et al*. 2018). Herbicides are also used to avoid trunk damage caused by mechanical weeding machinery (Keller 2015). Glufosinate is most widely used herbicide in the study area, but there is no standard recommendation on dosage of herbicide in grapes. Hence, urgent need to ascertain quantity of herbicide to be applied for management of mixed weed flora in grapes. Glufosinate is commonly used in management of broad spectrum of weeds (Jhala *et al*. 2013) as it catalyzes the synthesis of glutamine from glutamate and ammonia and plays a central role in plant nitrogen metabolism (Hanson *et al*. 2010). This mode of action unique among broad-spectrum herbicides is a key to mitigate developing resistance to other herbicides. Despite having high solubility glufosinate does not have soil activity and is highly mobile in soil and rapidly degraded by soil a microbe which is very much necessary to make lower herbicide resurgence in soil. Hence, in present experiment glufosinate-ammonium was tested for its bio-efficacy in comparison with hand weeding and weedy check. This study helps us to get more comprehensive adoptable weed management practices for vineyards of Nandi Valley of

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Karnataka.

MATERIALS AND METHODS

Studies on weed predominance of vineyards ecosystem: Knowledge on abundance of weeds species in a given locality is crucial in designing weed management modules. Hence, surveys on weed density and diversity was conducted in 24 young aged grapes orchard during 2018–19 in vineyards of Nandi Valley Latitude: 13° 23' 29.08" N Longitude: 77° 51' 53.57" E) of Karnataka. Weeds were counted in 240 quadrates, 10 quadrates (1 m × 1 m) each in 24 different orchards maintained by 24 grape growers. The observation was made randomly both at middle and bund side of the vineyard; different species of weeds appeared each quadrate was counted. The species density (SD) and relative density (RD) was calculated by using following formula.

$$\%\ \text{species density} = \frac{\text{Total number of weed in a quadrat}}{\text{Total area of quadrat (1m}^2\text{)}} \times 100$$

$$\%\ \text{relative density} = \frac{\text{Number of specific species of weed}}{\text{Total number of all weeds species}} \times 100$$

Management of mixed species of weed with selected broad spectrum herbicides: Concurrently, a field experiment was conducted for two consecutive years (2018 and 2019) to study the comparative performance of three broad spectrum post emergent herbicide. The experiment was laid out in Randomized Complete Block Design with four replications consisting of seven treatments, which includes glufosinate-ammonium 13.5% SL at 375, 495 and 615 g a.i./ha, diuran 80% WP at 1600 g a.i./ha, paraquat dichloride 24% SL at 1000g a.i./ha along with hand weeding and weedy check. Dosage of commercial product for the respective treatments was 2500, 3300, 4100, 2000 and 2000 ml/g/ha, respectively. These herbicides were applied on 16th December 2019 and 5th September 2020. Weeds usually interfere in post monsoon crop, study area receives characteristic bimodal rainfall peaks rainfall at April to June and August to October in each year. Hence, weed management treatments were imposed in later phases of *kharif* during both the years of experimentation. Herbicide was applied at active vegetative growth stage of weeds (4-6 leaf). Hand weeding was taken up twice at 20 and 40 days after treatment (DAT). Weed killing ability of herbicides were evaluated at 30 and 45 DAT on scale of 0 to 100 %, 0 being no control of weeds to 100 % being complete weed control at the time of observation compared with weedy check. The observations were recorded on species wise weed density at 30 and 45 DAT by randomly placing quadrate of 1 m × 1 m in each plot. The above ground portion of different species of weeds were harvested at 30 and 45 days after herbicide treatment, harvested weeds were placed in paper bag and were dried in an oven at 65 degree until obtain constant weight. Dried biomass was recorded as dry weight of weeds.

The data collected on weeds were transformed to square root transformation [“(x +0.5)] to meet assumption of variance for statistical analysis. Weed control efficiency

Table 1 Percent species density and relative density of weeds species in vineyards ecosystem of Nandi Valley (Average of 24 plots)

Group	Common name	Scientific name	% species density		% relative density	
			2018-19	2019-20	2018-19	2019-20
Grasses	Indian goose grass	*Eleusine indica*	6.52	7.73	3.42	4.21
	Egyptian grass	*Dactyloctenium aegyptium*	16.24	16.02	8.51	8.74
	Large crabgrass	*Digitaria sanguinalis*	30.81	29.04	16.15	15.84
	Cane grass	*Eragrostis* spp.	8.80	5.01	4.61	2.73
	Water crown grass	*Paspalidium* spp.	23.52	22.03	12.33	12.01
	Barnyard grass	*Echinochloa* spp.	3.95	4.72	2.07	2.57
	----	*Dinebra retroflexa*	2.43	6.87	1.27	3.74
	Signal grass	*Bracharia* spp.	7.74	8.58	4.06	4.68
BLW	Cocklebur	*Xanthium strumarium*	4.52	2.57	2.15	1.17
	Bengal dayflower	*Commelina benghalensis*	10.37	9.26	4.93	4.21
	Tossa jute	*Corchours* spp.	1.17	0.00	0.56	0.00
	Tamba	*Leucas aspera*	2.01	2.06	0.95	0.94
	Carrot Grass	*Parthenium hysteroporus*	24.75	24.19	11.77	11.00
	Goat weed	*Ageratum conizoides*	35.62	36.54	16.95	16.61
	Spanish needle	*Bidan pailosa*	7.36	7.37	3.50	3.35
	Spiny pigweed	*Amaranthus spimosis*	5.68	7.03	2.70	3.20
	Wild poinsettia	*Euphorbia geniculata*	8.53	10.98	4.06	4.99

Table 2 Effect of herbicide treatment on grasses and broad leaf weed density and weed biomass (g/m^2) at 30 and 45 days after herbicide treatment during 2018–19 and 2019–20

Treatment	Weed density								Weed biomass (g/m^2)							
	2018–19				2019–20				2018–19		2019–20		2018–19		2019–20	
	Grasses		BLW		BLW		Grasses		BLW		Grasses		BLW		Grasses	
	30 DAT	45 DAT	30 DAT	45 DAT	30 DAT	45 DAT	30 DAT	45 DAT	30 DAT	45 DAT	30 DAT	45 DAT	30 DAT	45 DAT	30 DAT	45 DAT
Glufosinate ammonium 13.5 % SL (375 g a.i./ha)	(27.33) 5.27	(32.67) 5.76	(31.33) 5.64	(52.67) 7.29	(35.67) 6.01	(31.33) 5.64	(46.00) 6.82	(52.00) 7.24	(8.32) 2.97	(11.12) 3.41	(12.89) 3.66	(17.32) 4.22	(13.14) 3.69	(14.08) 3.82	(17.94) 4.29	(19.24) 4.44
Glufosinate ammonium 13.5 % SL (495 g a.i./ha)	(3.67) 2.04	(5.67) 2.48	(12.33) 3.58	(15.33) 3.98	(10.00) 3.24	(11.00) 3.39	(20.33) 4.56	(19.00) 4.41	(1.08) 1.26	(1.14) 1.28	(6.74) 2.69	(8.74) 3.04	(1.24) 1.32	(2.16) 1.63	(7.93) 2.90	(7.03) 2.74
Glufosinate ammonium 13.5 % SL (615 g a.i./ha)	(1.00) 1.22	(4.00) 2.12	(7.67) 2.86	(11.33) 3.44	(6.67) 2.68	(4.33) 2.20	(13.00) 3.67	(12.33) 3.58	(0.31) 0.90	(1.00) 1.22	(3.14) 1.91	(7.68) 2.86	(6.13) 2.57	(0.14) 0.80	(5.07) 2.36	(4.56) 2.25
Diuron 80 % WP (1600 g a.i./ha)	(27.33) 5.27	(32.67) 5.76	(14.67) 3.89	(27.33) 5.27	(35.33) 5.98	(34.67) 5.93	(21.00) 4.63	(29.00) 5.43	(9.14) 3.10	(9.13) 3.10	(8.08) 2.93	(15.17) 3.96	(14.56) 3.88	(13.68) 3.76	(8.19) 2.95	(10.73) 3.35
Paraquat dichloride 24 % SL (500 g a.i./ha)	(15.00) 3.94	(19.00) 4.41	(26.33) 5.18	(29.67) 5.49	(29.33) 5.46	(34.33) 5.90	(39.33) 6.31	(35.33) 5.98	(5.12) 2.37	(13.14) 3.69	(10.14) 3.26	(17.12) 3.53	(14.21) 3.83	(15.14) 3.95	(15.34) 3.98	(13.07) 3.68
Hand weeding (at 20 and 40 days)	(0.00) 0.71	(0.00) 0.71	(1.67) 1.47	(0.00) 0.71	(0.00) 0.71	(1.00) 1.22	(0.00) 0.71	(3.00) 1.87	(0.00) 0.71	(0.00) 0.71	(0.49) 0.99	(0.00) 0.71	(0.00) 0.71	(0.00) 0.71	(0.00) 0.71	(0.13) 0.79
Weedy check	(202.67) 14.25	(219.67) 14.83	(207.33) 14.41	(221.00) 14.88	(213.00) 14.61	(219.67) 14.83	(209.33) 14.48	(219.67) 14.83	(43.68) 6.64	(56.00) 7.51	(67.45) 8.24	(71.74) 8.50	(56.32) 7.53	(49.74) 7.09	(81.64) 9.06	(81.28) 9.04
SEm±	0.24	0.32	0.82	0.33	0.24	0.29	0.47	0.45	0.22	0.41	0.44	0.45	0.20	0.43	0.22	0.62
LSD (P=0.05)	0.73	0.98	2.52	1.01	0.73	0.91	1.44	1.38	0.67	1.26	1.36	1.40	0.60	1.33	0.69	1.92

* Values in the parenthesis are transformed values; BLW- broad leaf weeds; DAT- days after treatment.

(WCE) was calculated on the basis of data recorded at 30 and 45 days after herbicide treatment as per the formula suggested by Mani *et al*. (1976). The data were subjected to ANOVA, means were separated at P=0.05 with Fishers' LSD test.

RESULTS AND DISCUSSION

Studies on weed predominance of vineyards ecosystem: In the present study, the weed analysis indicated that about 17 weed species which includes seven grasses and eight BLW were found predominant (Table 1). Primary grass weeds noticed at vineyard of Nandi Valley were *Eleusine indica, Dactyloctenium aegyptium, Digitaria sanguinalis, Eragrostis* spp., *Paspalidium* spp., *Echinochloa* spp., *Dinebra retroflexa* and, *Bracharia* spp., likewise *Xanthium strumarium, Commelina benghalensis, Corchours* spp., *Leucas aspera, Parthenium hysteroporus, Ageratum conizoides, Bidan pailosa, Amaranthus spimosis* and *Euphorbia geniculata* were predominant BLW (Table 1). Among the grass weeds *Digitaria sanguinalis* (30.81 and 29.04%, respectively during 2018 and 2019) and *Paspalidium* spp., (23.52 and 22.03 %, respectively during 2018 and 2019) could be rated as highly predominant being much higher species density than the other species. Among the BLW *Ageratum conizoides* (35.6 and 36.54%, respectively during 2018 and 2019) and *Parthenium hysteroporus* (24.75 and 24.19%, respectively during 2018 and 2019) were the predominant weed species and recorded highest species density (Table 1). However, highest relative density was also observed with *Digitaria sanguinalis* (16.15 and 15.84%, respectively during 2018 and 2019) and *Paspalidium* spp., (12.33 and 12.01, respectively during 2018 and 2019). Again *Ageratum conizoides* and *Parthenium hysteroporus* proved to be dominant weed flora and recorded with higher relative density.

Generally BLW were observed more compared with grasses as it could be seen in higher per cent relative density. Among the various weeds, *Ageratum conizoides* and *Parthenium hysterophorus* proved to be the dominant weed flora of experimental site. Predominance of *Ageratum conizoides* and *Parthenium hysterophorus* in near premises of study area in corn ecosystem was earlier reported by Nagarjun *et al.* (2019). *Ageratum conizoides* and *Parthenium hysterophorus* are the members of *Asteraceae* family, producing thousands of small white capitula each yielding five seeds on reaching maturity. Due to their high fecundity a single plant can produce 10000 to 15000 viable seeds and these seeds can disperse and germinate to cover large areas (Patel 2011, Saha *et al*. 2020). Predominance of *Ageratum conizoides* and *Parthenium hysterophorus* was again traced back to the continuous application of paraquat for the management of weeds in study area. Paraquat typically having greater efficacy against grassy weeds and is having limitation in controlling BLW and could be the probable reason for predominance of *Ageratum conizoides* and *Parthenium hysterophorus* (Congreve and Cameron 2018).

Management of mixed species of weed with selected broad spectrum herbicides: Bio-efficacy of three selected broad spectrum herbicide was evaluated on mixed weed situation of grasses and BLW. Regardless of herbicides applied better control was achieved with herbicide treatment when compared with weedy check at 30 and 45 days after herbicide treatment (Table 2). Among the herbicides, glufosinate ammonium 13.5% SL applied at 615 g a.i./ha resulted better control of weeds by recording significantly lower number of grassy weeds, *i.e.* 1.00 and 4.00, respectively at 30 and 45 DAT in 2018 and 6.67 and 4.33, respectively at 30 and 45 DAT in 2019 (Table 2). With regards to BLW again plots treated with glufosinate ammonium 13.5% SL applied at 615 g a.i./ha exhibited better control of BLW too by recording significantly lower number of weeds, i.e. 7.67 and 11.33, respectively at 30 and 45 DAT in 2018 and 13.00 and 12.33, respectively at 30 and 45 DAT in 2019 (Table 2). Regardless of grass and BLW, application of glufosinate ammonium 13.5% SL applied at 495 g a.i./ha was statistically comparable with that of glufosinate ammonium 13.5% SL applied at 615 g a.i./ha. Glufosinate ammonium proved to be the excellent herbicide in burn done and residual weed control in cropped and non-cropped area (Banerjee *et al.* 2018). In present study, effective kill of grassy weeds was observed with plots treated with glufosinate ammonium 13.5 % SL at 615 g a.i./ha both in terms of weed density and weed biomass (Table 2). Significant excellence in controlling weeds was also evident by recording higher grassy WCE in the same plots at 30 and 45 DAT during both the years (Fig 1). Similar trends were also noticed with BLW wherein application of glufosinate ammonium 13.5% SL at 615 g a.i./ha recorded higher BLW control efficiency at 30 and 45 DAT during both the years (Fig 1).

Yield attributes and yield: The grape yield was found on par in all the herbicidal treatment during both the years of experimentation (Fig 2). However, treatment with herbicide applications was significantly superior over weedy check. Significant improvement in yield was traced back to higher weight of berries harvested which is obvious, effective and timely control of weeds under herbicide treatment resulted in significantly improvement in berries yield and was ultimately reflected as yield (Fig 2). As a result of excellent and full season weed control with glufosinate ammonium 13.5 % SL led to significantly higher grape yield than weedy check. Glufosinate-ammonium13.5 % SL showed greater efficacy on mixed weed population than paraquat and diuron when applied at 615 and 495 g a.i./ha. Glufosinate ammonium is a broad spectrum (Mohamad *et al*. 2010) and partially systemic (Banerjee *et al.* 2018) that tends to give more persistent control of grasses and BLW than paraquat and diuron.

Based on the results of this experiment, weeds infestation of vineyards of Nandi Valley are the mixed species of grasses and BLW. Among mixed community of weeds, BLW found predominant over grasses by recording greater species and relative density. The results of herbicide efficacy indicated that, application of glufosinate ammonium

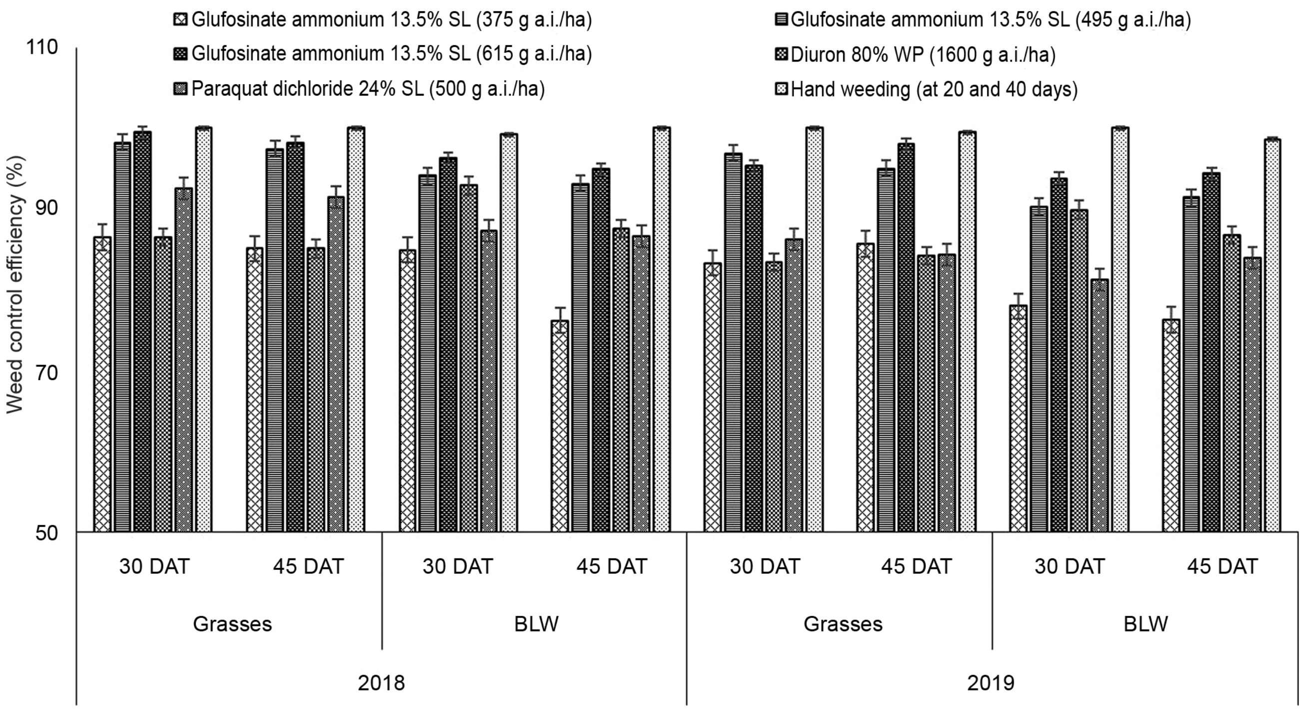

Fig 1 Effect of herbicide treatment on weed control efficiency at 30 and 45 days after herbicide application during 2018–19 and 2019–20.

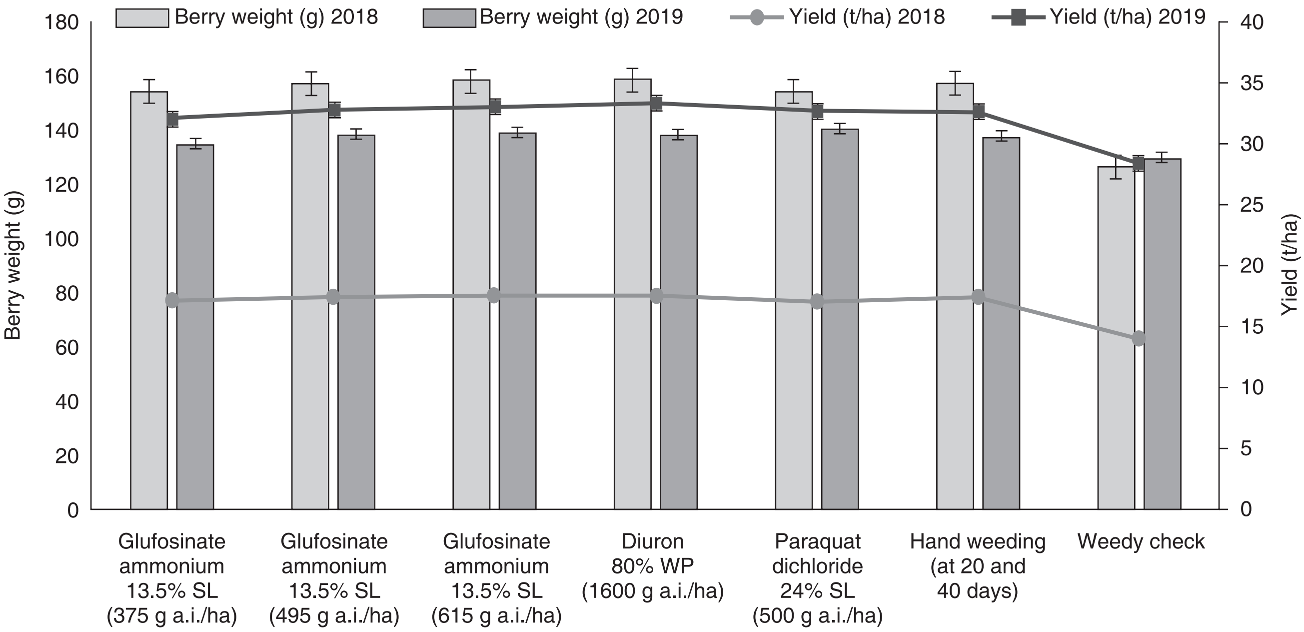

Fig 2 Effect of herbicide treatment on berry weight and grapes yield during 2018–19 and 2019–20.

13.5% SL at 615 g ai/ha found to superior in providing effective weed kill, weed growth reduction, duration of control of mixed weed population and was comparable with glufosinate ammonium 13.5% SL at 495 g ai/ha was comparable in effective management of mixed weed flora of vineyards of Nandi Valley.

REFERENCES

Asaduzzaman M, Pratley, Min An, Luckett D J and Lemerle D. 2014. Canola interference for weed control. *Springer Science Reviews* **2**: 63. https://doi.org/10.1007/s40362-014-0022–2

Banerjee S, Kundu R, Bera S and Soren C. 2018. Bio-efficacy and phytotoxicity of glufosinate ammonium 13.5% SL on weed flora of tea. *Journal of Crop and Weed,* **14**(3): 161–64

Congreve M and Cameron J. 2018. Understanding post-emergent herbicide weed control in Australian farming systems - a national reference manual for agronomic advisers. pp-1-96. https://grdc.com.au/understanding-post-emergent-herbicide-weed-control.

Gaba S, Fried G, Kazakou E, Chauvel B and Navas M L. 2014.

Agroecological weed control using a functional approach: a review of cropping systems diversity. *Agronomy for Sustainable Development* **34**(1): 103–119. DOI 10.1007/s13593-013-0166-5.

Keller M. 2015. *The Science of Grapevines*, 2nd edn. Elsevier, Oxford, pp 552.

Mohamad R B, Wibawa W, Mohayidin M G, Puteh A B, Juraimi A S, Awang Y and Lassim M B M. 2010. Management of mixed weeds in young oil-palm plantation with selected broad-spectrum herbicides. *Pertanika Journal of Tropical Agricultural Science* **33**(2): 193–203.

Nagarjun P, Dhanapal G N, Sanjay M T, Yogananda S B and Muthuraju R. 2019. Energy budgeting and economics of weed management in dry direct-seeded rice. *Indian Journal of Weed Science* **51**(1): 1–5.

Patel S. 2011. Harmful and beneficial aspects of *Parthenium hysterophorus*: an update. *3 Biotechnology* **1**: 1–9. https://doi.org/10.1007/s13205-011-0007-7

Saha B, Kauser H, Khwairakpam M and Kalamdhad A S. 2020. Effect and management of various terrestrial weeds—review. *(In)* Kalamdhad A. (eds) Recent Developments in Waste Management. Lecture Notes in Civil Engineering, vol 57. Springer, Singapore

Zaller J G, Clemens C, Santos G D, Muther S, Gruber E, Pallua P, Mandl K, Friedrich B, Hofstetter I, Schmuckenschlager B and Faber F. 2018. Herbicides in vineyards reduce grapevine root mycorrhization and alter soil microorganisms and the nutrient composition in grapevine roots, leaves, xylem sap and grape juice. *Environmental Science and. Pollution Research* **25**: 23215–26.