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Evaluation of defoliant and detection of its residues as harvesting aids in greengram (*Vigna radiata* L.)

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Abstract

A experiment was conducted at Regional Agricultural Research Station, Warangal (18°03', 79°22' and 270 m AMSL) Telangana, India during Kharif (June-September, 2015 and 2016). The defoliant Glyphosate @ 8 ml/l + Ammonium sulphate @ 8 g/l; Paraquat @ 4 ml/l; urea @ 200 g/l; ZnSo₄; MnSo₄; and MnCl each @ 30 g/l with water as control were sprayed on greengram at physiological pod maturity. The designated seven treatments were imposed in Randomized Block Designed and replicated thrice. Leaves count/m² was taken before and at 3, 5, 7 and 10 days after defoliant spraying. The harvested seed were tested for germination percentage. Spraying of paraquat @ 4 ml/l at Physiological pod maturity caused drying and fall of greengram leaves to 92 percent by the 3 days after defoliant spraying and 100 percent by the 7 days after defoliant spraying, followed by glyphosate @ 8 ml/l which influenced the defoliation to 93 percent by the 7 days after defoliant spraying and 99 percent by the 10 days after defoliant spraying. There paraquat and glyphosate were significantly superior to control as well as other defoliant. Increased work efficiency because of less interference of leaves in harvesting of pods. Defoliant traces were not detected in grain and plant, and the germination percentage of seed was also not affected. The research study indicated possibility of defoliant as harvesting aids in greengram as they are easily available and are without any residues.

Keywords: Evaluation, greengram, *Vigna radiata* L.

Introduction

India is the largest producer and consumer of greengram and it alone accounts of greengram for about 65% of the world acreage and 54% of the world production (Singh and Singh, 2011)^[6]. For production of greengram harvesting scarcity of Labour urbanization is major constraint, delay in harvesting which cause shattering of pods and during rain deteriorate seed quality. Mechanical harvesting is advisable for timely harvesting of greengram and to overcome labour shortage. To facilitate mechanical harvest defoliation of the crop is essential as, the greengram foliage does not abscise, completely when pods are dry, could affect working efficiency of machine, which leads to deteriorate grain quality and storage difficulty. Harvest aids accelerate the harvest of a crop there by reducing losses from inclement weather and provide more efficient and faster harvesting.

Paraquat use as defoliant in greengram, may pose residual effect on health hazards to human and animals due to accumulation of residues in grains or plant parts. Available literature indicates that information on defoliant residues in greengram grains or plant parts is scanty. There is a need to monitor bioaccumulation of paraquat or defoliant residues and adverse effects on seed germination and quality, if any. Residues data was further strengthened by paraquat recommended as defoliant in greengram.

Materials and Methods

A experiment was conducted at Regional Agricultural Research Station, Warangal (18°03', 79°22' and 270 m AMSL) Telangana, India during *Kharif* (June-September, 2015 and 2016). The defoliant Glyphosate @ 8 ml/l + Ammonium sulphate @ 8 g/l; Paraquat @ 4 ml/l; urea @ 200 g/l; ZnSo₄; MnSo₄; and MnCl each @ 30 g/l with water as control were sprayed on greengram at physiological pod maturity. The designated seven treatments were imposed in Randomized Block Designed and replicated thrice. The soil of the experimental field was sandy loam, low in organic carbon (0.27%) and available N(260 kg/ha), medium in available phosphorus (24 kg/ha) and potassium(285 kg/ha). Greengram crop variety WGG -42 was sown on July 5th in 2015 and July 12th in 2016. Pendimethalin (Stomp 30 EC) herbicide @ 5ml/l of water sprayed on the same day.

All the cultivation practices were followed as per the recommendations to the region. During the whole crop period, the rainfall of 543.8 and 307.7 mm was received in 2015 and 2016, respectively. The data on leaves count/m² was taken before and at 3, 5, 7 and 10 days after defoliant spraying were collected from randomly selected five plants per plot. The harvested 100 seeds were selected randomly from each defoliated plots for tested germination percentage using a petri dish and Whatman filter paper, and also sown in the soil, the trial area was covered by nylon net to avoid birds damage. For detecting defoliant residues content in plant parts i.e. leaves, grains, haulm were randomly collected from selected plants and properly sun dried for pounding for lab analysis.

Results and Discussion

Results revealed that spraying of paraquat @ 4 ml/l at Physiological pod maturity, there was drastic reduction in leaf moisture and chlorophyll content, which increased dryness and fall of greengram leaves to greater extent 92 percent by the 3 days after spraying and 100 percent by the 7 days after spraying, followed by glyphosate @ 8 ml/l which influenced the defoliation to 93 percent by the 7 days after spraying and 99 percent by the 10 days after spraying. paraquat and glyphosate were significantly superior to absolutely control/water sprayed as well as other defoliant. (Table 1). These results are in agreement with Keerti and Ganajaximath (2017) [2, 3] and Padmaja *et al.* (2013) [4]. Paraquat acts by intercepting electrons on the reducing side of photosystem-I and cause rapid inactivating chlorophyll and oxidising chloroplast membrane, lipid and enhance drying of the crop (Thomas *et al.* 2013) [8].

Terminal residues of defoliant (paraquat @ 4ml/l and glyphosate 8ml/l) were monitored in the greengram sprayed

as harvesting aids at Physiological pod maturity. Paraquat residues were found to be below the detection limit of 0.001 µg /g in grain, 0.002 µg /g in haulm, 0.025 in leaves and 0.03 in complete plant. Glyphosate residues were found to be below the detection limit of 0.009 µg /g in grain, 0.010 µg /g in haulm, 0.04 in leaves and 0.10 in complete plant. There are two herbicides residues were above safe level, not/negligible detected in greengram grain and plant samples after harvest of crop. Aktar *et al.* 2009 monitored no residues of pre emergence trifluralin were detected in blackgram plant sample at harvest. Sondhia 2014 observed post emergence quizolofop ethyl on blackgram seed and foliage were found to be below the detection limit of 0.01mg/kg.

Protein content (% by mass) in greengram grain contain 19.10 percent in absolutely control/water sprayed sample (Table 4), it was varied in defoliant sprayed samples i.e., paraquat, MnCl₂ and glyphosate 15.62, 16.94 and 17.75 percent respectively, which was reduced protein content in grain in terms of percentage 18.2, 11.3 and 7.0 respectively, with absolutely control/water sprayed. These results are contradictory with the findings of Keerti and Ganajaximath (2017) [2, 3]. The grain yield of greengram was not significantly affected by spraying of the defoliant; it was corroborated with findings of Padmaja *et al.* (2013) [4].

The germination percent of greengram seed not differed significantly among defoliant sprayed at physiological pod maturity in greengram crop (Table 4). This indicated that defoliant not impose adverse effect on germination of greengram seed. Similar results were also observed by Keerti and Ganajaximath (2017) [2, 3] and Salari *et al.* (2013) [5] who reported that paraquat @ 5 ml/l of water spraying at 65 and 75 days after greengram sowing did not have any adverse effects on seed germination of greengram and cotton.

Table 1: Influence of different defoliant on greengram defoliation in *kharif* pooled of 2015 and 2016

Defoliant	Days after defoliant application								
	No. of leaves/m ²	No. of leaves/m ²				percentage of defoliation			
		Before defoliant	3	5	7	10	3	5	7
Paraquat	496	43	0	0	0	92 (73.7)	100 (90.0)	100 (90.0)	100 (90.0)
Glyphosate	522	248	137	37	0	52.5 (46.4)	74.0 (59.4)	93.0 (75.0)	100 (90.0)
Urea	684	354	324	228	10	48.2 (43.9)	52.6 (46.5)	66.6 (54.7)	98.5 (84.5)
ZnSO ₄	730	470	435	176	130	35.6 (36.6)	40.5 (39.5)	75.9 (60.6)	82.2 (65.1)
MnSO ₄	635	388	234	118	69	38.9 (38.6)	63.0 (52.5)	81.5 (64.5)	89.2 (71.0)
MnCl ₂	493	265	241	124	52	46.2 (42.8)	51.2 (45.7)	74.8 (59.9)	90.0 (71.7)
Control (Water spray)	564	491	450	386	270	13.0 (21.1)	20.2 (26.7)	31.5 (34.1)	52.3 (46.3)
SEm +	-	-	-	-	-	0.97	0.99	1.57	1.62
CD (P=0.05)	-	-	-	-	-	3.0	3.2	3.5	5.0
CV (%)	-	-	-	-	-	3.87	3.26	3.08	3.78

*Values in bracket the parentheses are the *arc* sine transformation of the percentage

Table 2: Residues of defoliant in greengram as harvesting aids

Defoliant	Grain	Haulm	Leaves	Plant
Paraquat (µg /g)	0.001	0.002	0.025	0.03
Glyphosate (µg /g)	0.009	0.010	0.04	0.10
Nitrogen (% by mass)-Urea	0.15	0.07	0.12	0.15
Zn as ZnSO ₄ (ppm)	94.44*	468.52*	90.14*	437.65*
Mn as MnSO ₄ (ppm)	39.51*	180.52	445.64*	417.23
Mn as MnCl ₂ (ppm)	69.11	566.63	737.31*	107.73
Zn as Zn (mg/l)	38.25	189.16*	36.51	177.26

Mn as Mn (mg/l)	14.39	65.64	162.06*	151.72
Sulphate as So ₄ (%)	0.54	0.81	1.36*	1.10
Chloride as Cl (%)	0.08	0.08	0.06	0.07

Table 3: Control (water spray) sample

Defoliant Particulars	Paraquat	Glyphosate	N (%)	Zn (ppm)	Mn (ppm)	So ₄ (%)	Cl (%)
Grain	-	-	0.15	23.17	9.51	0.52	1.36
Haulm	-	-	0.07	22.80	30.80	0.18	1.35
Leaves	-	-	0.12	24.24	65.54	0.26	2.01
Plant	-	-	0.15	284.48	163.49	0.36	2.03

Table 4: Protein content, Germination (%) and grain yield of greengram as influenced by defoliant on greengram crop defoliation in *kharif* pooled of 2015 and 2016

Defoliant	Protein content (% by mass) in grain	Germination percent of seed	Grain Yield (kg per ha)
Paraquat	15.62*	90.8	1111
Glyphosate	17.75*	89.8	1055
Urea	19.00	88.5	1073
ZnSO ₄	19.40	90.2	1089
MnSO ₄	20.20	90.3	1038
MnCl ₂	16.94*	89.2	1046
Control (Water spray)	19.10	91.0	1159
SEm +	-	0.33	36.9
CD (P=0.05)	-	NS	NS
CV (%)	-	0.62	5.9

Conclusion

Paraquat @ 4 ml/l of water is sprayed as defoliant at physiological maturity (a week before harvesting) of greengram crop to defoliation and facilitates easy machine harvesting with non significant grain yield loss compared to non defoliant by manual harvesting as well as germination percent of seed. Residues of paraquat@ 4 ml/l of water were not traceable either in grain or haulm and complete plant.

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