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Weed management strategies in green gram: A review

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Abstract
Green gram (*Vigna radiata* L.) is one of the most important pulse crops. Green gram can be grown in all the seasons of the year *viz*., *kharif, Rabi* and *summer*. Green gram production requires a lot of labour, particularly for weed management practices. Weed spectrum depends on the efficiency of the green gram ecosystem and control measures adopted. The most possible way for controlling weeds is by manipulating the cropping system and making conditions more favourable for crop growth and unfavorable for weed growth. Weeds belonging to various groups *viz.,* grasses, sedges and broad-leaved weeds (BLW) were associated in green gram cultivation. Severe infestation of weeds causes about 30 to 80 per cent of yield loss in green gram. Weed management strategies viz., preventive, cultural, mechanical, chemical and biological methods have to be followed judiciously to reduce the weed problem in green gram. The common weed control method used is the hand weeding which is time consuming and also difficult to control weeds. Combination of pre and post emergence herbicides or some ready-mix herbicide formulations reduces the crop weed competition and effectively manages the weed flora in green gram. One such example is application of PE Pendimethalin+ Imazethapyr 1 kg/ha *fb* POE Fluazifop-p-butyl+ Fomesafen 313 g/ha recorded the lowest total weed density, total weed dry weight, higher weed control efficiency, grain and haulm yields of green gram.

Keywords: Green gram, weed management, weeds flora, growth and yield

Introduction
Pulses are rich source of dietary proteins and inseparable ingredients of vegetarian diet. India contributes about 25 per cent of global pulse production. India is the first largest producer of pulses in the world. Green gram (*Vigna radiata* L.) is one of the most important pulse crops in India, ranks third in production. Green gram can be grown in all the seasons of the year *viz*., *kharif, rabi* and *summer*. In India, green gram is grown in an area of 4.75 M ha with production of 2.45 M tonnes and average productivity of 516 kg ha^{-1} (Indiastat, 2019-20) [21]. Summer irrigated black gram and green gram are being raised after the harvest of *samba/thaladi* paddy, in Cauvery delta region of Tamil Nadu, where the ground water level is sufficient (Senthil Kumar *et al*., 2017) [61]. During *summer,* frequent irrigation may cause severe weed infestation. Weeds are fast growing in nature having enormous seed production capacity compared to crops. The weed seeds spread easily and their life cycle coincide with the crop, which reduces the crop yield (Mahroof *et al.*, 2009) [30]. Algotar *et al.* (2015) [3] reported that 30 to 80 per cent of yield loss in green gram was observed due to severe weed infestation. So there is a need to control weeds in order to reduce the yield loss in green gram. Therefore, it is important to develop cost effective weed management practices for improving the productivity and profitability of green gram.

The total annual agricultural production losses were mainly caused by weeds (45%) followed by insects (30%), diseases (20%) and other causes (5%) (Ankit Kumar Ghorai *et al.*, 2020) [4]. Effective weed management practices are more important for green gram cultivation. The manual weeding is the most effective method for controlling weeds but it is laborious, time consuming and costly. During peak period of weed infestation, the unavailability of labour and increasing labour wages necessitates the herbicidal application for weed control in green gram. One of the best choices for controlling weeds is the application of herbicides at appropriate level. Herbicides control the weeds effectively and is economically feasible one (Muoni *et al.*, 2013) [39]. Application of pre emergence (PE) and post emergence (POE) herbicides at appropriate level helps to control the weeds in peak period. Mishra *et al.* (2017) [34] reported that combination of pre and post emergence herbicides or some ready-mix herbicide formulations reduces the crop weed competition and effectively manages the weed flora in green gram. Various weed management strategies in green gram are reviewed in this chapter.

Weed flora in green gram field

Dominant weeds associated with green gram were *Dactyloctenium aegyptium*, *Chloris barbata*, *Cynodon dactylon* among grasses, *Cyperus rotundus* among sedges, *Phyllanthus niruri*, *Boerhavia diffusa*, *Cleome viscosa*, *Trianthema portulacastrum*, *Digera muricata* and *Tridax procumbens* among broad leaved weeds (BLW) (Natarajan *et al*., 2003) [44]. The density of *Cyperus rotundus*, *Amaranthus viridis*, *Boerhavia diffusa*, *Commelina benghalensis*, *Convolvulus arvensis*, *Corchorus fascicularis*, *Corchorus olitorius*, *Desmodium triflorum*, *Digera arvensis*, *Euphorbia hirta*, *Euphorbia microphylla*, *Phyllanthus niruri*, *Phyllanthus maderaspatensis*, *Trianthema portulacastrum* and *Tribulus terrestris* were higher in proportion in green gram (Punia *et al*., 2004) [51]. Gaganpreet Kaur *et al.* (2009) [17] revealed that *Cyperus rotundus*, *Trianthema portulacastrum* and *Eragrostis tenella* were dominant in green gram. In green gram, *Panicum colonum*, *Cynodon dactylon*, *Cyperus rotundus*, *Digera arvensis*, *Euphorbia hirta*, *Leucas aspera*, *Phyllanthus niruri*, *Portulaca oleracea*, *Indigoflora glandulosa*, *Phyllanthus niruri* were the major weeds observed by Chhodavadia *et al.* (2011) [11].

Green gram experimental field was infested with *Cyperus rotundus* among sedge, *Dactyloctenium aegyptium*, *Echinochloa colona* among grasses and *Commelina diffusa*, *Amaranthus viridis*, *Digera arvensis*, *Parthenium hysterophorus*, *Phyllanthus niruri* among BLW (Khairnar *et al*., 2014) [22]. Guriqbal Singh *et al.* (2015) [20] observed that *Cyperus rotundus* among sedge, *Dactyloctenium aegyptium* among grass and *Trianthema portulacastrum*, *Commelina benghalensis* among BLW were dominant weeds in green gram. Chaudhari *et al.* (2016) [9] stated that in green gram, major weed flora observed were *Cyperus rotundus* in sedges, *Cynodon dactylon*, *Digitaria sanguinalis*, *Echinochloa crusgalli* in grasses, *Amaranthus viridis*, *Alternanthera pungens*, *Convolvulus arvensis*, *Digera arvensis*, *Eclipta alba*, *Euphorbia hirta*, *Physalis minima*, *Sorghum halepense*, *Trianthema portulacastrum*, *Vernonia cinerea* in BLW. The weed flora emerged during the period of experimentation *Chloris barbata*, *Cynodon dactylon*, *Dactyloctenium aegyptium* among grasses, *Cyperus rotundus* among sedge, *Phyllanthus niruri*, *Boerhavia diffusa*, *Cleome viscosa*, *Trianthema portulacastrum*, *Digera muricata* and *Tridax procumbens* among BLW which was reported by Muthuram *et al.* (2017) [40].

Muthuram *et al.* (2018) [41] noticed that in green gram, under irrigated condition *Dactyloctenium aegyptium*, *Chloris barbata*, *Cynodon dactylon* among grasses, *Cyperus rotundus* among sedge and BLW were *Phyllanthus niruri*, *Boerhavia diffusa*, *Cleome viscosa*, *Trianthema portulacastrum*, *Digera muricata* and *Tridax procumbens.* Guriqbal Singh *et al.* (2019) [19] stated that *Cyperus rotundus*, *Eleucine aegyptiacum* and *Commelina benghalensis* were the major weeds in green gram *Commelina foecunda*, *Corchorus fascicularis*, *Sorghum halepense*, *Dinebra retroflexa* were the dominant weed species observed in green gram field reported by Zena Wigebregergis *et al.* (2019) [78]. Srijani Maji *et al.* (2020) [70] noticed that *Cyperus rotundus* among sedge, *Cynodon dactylon*, *Dactyloctenium aegyptium*, *Echinochloa colona* and *Eleusine indica* among monocots, *Portulaca oleracea*, *Physalis minima*, *Amaranthus viridis*, *Euphorbia hirta* and *Alternanthera philoxeroides* among dicots were dominated weeds in green gram. Kuldeep Singh *et al.* (2021) [25] noticed that most dominant weed species found in green gram field were *Cynodon dactylon* and *Panicum repens* in grasses, *Cyperus roduntus* in sedges and BLW were *Amaranthus viridis*, *Digera arvensis*, *Trainthema portulacastrum* and *Portulaca oleracea.*

Critical period of weed competition

The period of crop growth sensitive to weed competition among the different growth stages is called as Critical period of weed competition. It begins when both competes with each other for same resources such as nutrients, light, space and water at the same time. Weeds grow faster when compared to crop and takes available resources during competition and makes the crop to starvation. Hence, this ultimately affects the crop growth which finally leads to yield loss. Saxena (1979) [60] stated that the weeds affect the seed quality and cause losses in green gram yield of about 30 to 50 per cent. Singh *et al.* (1996) [68] observed that the critical period of weed competition in green gram was first 45 days after sowing (DAS). Mishra (1997) [33] opined that potential yield loss was minimized by controlling weeds during critical period. The green gram yield was reduced due to weed competition during 20 to 30 days after emergence (Naeem *et al*., 1999) [42]. Vaishya *et al.* (2003) [75] opined that in *summer,* green gram yield loss of about 46 to 53 per cent has been reported due to weeds. Arif *et al.* (2006) [6] stated that weeds compete with crops such as nutrient, space and water causing reduction in crop yield and quality. In green gram, weed free up to 7 DAS registered lower weed density and dry weight which results in higher grain yield (Dipali Mandal *et al*., 2006) [14].

Sheoran *et al.* (2008) [64] stated that due to weed competition in green gram, yield loss occurs of about 38 per cent and also reported that the critical period of weed competition was 20 DAS. Knowledge about the critical period for weed competition is essential for adopting the proper weed management practices (Kundu *et al*., 2011) [28]. Singh *et al.* (2015) [69] stated that when green gram was severely infested with weeds during critical stages there was a yield reduction between 30 to 85 per cent. Dinesh Jinger *et al*. (2016) [13] reported that slow growth of green gram was observed during 4 to 5 weeks after sowing (WAS) as the crop was sensitive to weed competition in those days. In rainy season weed infestation was severe in first 30 DAS due to fast growing of weeds (Guriqbal Singh *et al*., 2019) [19]. In green gram, productivity was reduced upto 56.7 per cent due to weeds which was estimated by Shriram Osari *et al.* (2019) [65]. Arvind Verma and Roshan Choudhary (2020) [7] opined that critical period of crop weed competition in green gram was around 20 to 30 DAS.

Methods of weed control

Hand weeding

Weed control practices was one of the most important factor for crop growth. In green gram, inter culturing and hand weeding were the effective methods to remove monocot and dicot weeds without affecting the yield (Kumar and Kundra, 2001) [26]. Patel *et al.* (2005) [47] noticed that hand weeding on 30 and 45 DAS registered maximum grain yield. At harvest stage of green gram, inter culturing and HW at 20 and 40 DAS registered lower BLW (Malliswari *et al*., 2008) [32]. In green gram, lower weed population, dry matter accumulation and higher WCE were recorded in two HW at 20 and 35 DAS (Veeraputhiran, 2009) [76]. Right time of hoeing controls the

weeds in mung bean and delayed hoeing causes economic losses (Gaganpreet Kaur *et al.*, 2010) [18]. Chhodavadia *et al.* (2011) [11] noticed that two HW at 20 and 40 DAS registered lower WI and higher WCE in green gram. Algotar *et al.* (2014) [2] noticed that two HW and hoeing (weed free up to harvest) resulted in taller plant and highest number of branches plant^{-1} in green gram.

In green gram, weed free plot registered the highest plant height (49.80 cm) and number of branches plant^{-1} (9) which was reported by Chaudhari *et al.* (2016) [9]. Lower weed density and dry weight were obtained under two HW on 15 and 30 DAS in green gram (Om Prakash Shivran *et al.*, 2017) [45]. Leva *et al.* (2018) [29] reported that economic returns and production potential were higher in two HW and inter culturing at 20 and 40 DAS. The lowest weed density and dry matter were noticed with HW at 20 and 40 DAS in green gram (Poornima *et al.*, 2018) [50]. Randhir Kumar *et al.* (2018) [56] registered that in green gram higher plant height, DMP and crop growth rate were obtained by HW at 15 and 30 DAS.

In green gram, weeds were effectively controlled by two HW at 15 and 30 DAS (Satybhan Singh *et al.*, 2019) [59]. Sudesh Kumar *et al.* (2019) opined that in green gram the tallest plant (43.3 cm) and maximum number of branches plant^{-1} (8.3) were recorded under two manual weeding at 20 and 35-40 DAS. The lowest WI and higher WCE in green gram were recorded in HW at 20 and 40 DAS (Patel *et al.*, 2020) [49]. Sasode *et al.* (2020) [58] reported that HW at 20 and 40 DAS reduced the total weed population and weed dry weight. In irrigated green gram, lower weed density, dry weight and higher WCE were recorded in hand hoeing at 20 and 30 DAS (Senthivelu *et al.*, 2020) [62]. HW at 20 and 40 DAS registered the highest seed and haulm yields in green gram (Mukherjee, 2021) [38].

Chemical weed management

Manual and mechanical method of weed control was labourious and economically high due to unavailability of labour and increased labour wages (Dungarwal *et al.*, 2003) [16]. Alternatively chemical weed control provides weed free condition during critical stages. To reduce the production cost, chemical weed control was better option compared to the manual method (Ramesh and Rathika, 2016) [54]. Komal *et al.* (2015) [24] stated that herbicides are used for complete control of weeds because of their selectivity on weeds. In green gram, effective method of weed control was achieved by herbicide application (Shruthi and Salakinkop, 2015) [66]. Narendra Kumar *et al.* (2017) [43] opined that in green gram maximum plant height, number of nodules plant^{-1} and higher nodule dry weight were observed in PE Pendimethalin at 1.25 kg ha^{-1} + POE Imazethapyr at 100 g ha^{-1}. Chavan *et al.* (2018) [10] opined that PE application of Pendimethalin at 1.0 kg ha^{-1} + POE Quizalofop ethyl at 40 g ha^{-1} resulted higher plant height in green gram. Application of PE Pendimethalin at 1.0 kg ha^{-1} + POE Imazethapyr at 50 g ha^{-1} registered higher WCE and grain yield in green gram (Ramesh and Rathika, 2020) [55]. Chemical weed management is the best and economically viable method for controlling weeds. Similarly, Udhaya *et al.* (2021) [74] reported that application of PE Pendimethalin+ Imazethapyr 1 kg/ha *fb* POE Fluazifop-p-butyl+ Fomesafen 313 g/ha recorded the lowest total weed density, total weed dry weight, higher weed control efficiency, grain and haulm yields of green gram.

Integrated Weed Management (IWM)

Effect of IWM on weed control

IWM practices were effective weed control measure to shift crop weed competition in favor of crop by adopting different control measures *viz*., chemical, cultural, mechanical and biological (Shweta and Singh, 2005) [67]. PE application of Pendimethalin at 1.0 kg ha^{-1} + HW at 30 DAS registered effective weed control in green gram (Raman and Krishnamoorthy, 2005) [52]. Kundu *et al.* (2009) [27] stated that in green gram lower weed density, dry weight and higher WCE were registered with application of Quizalofop-p-ethyl at 50 g ha^{-1} + HW at 28 Days after emergence. Kundu *et al.* (2011) [28] stated that in green gram, lower grass density was recorded under application of Quizalofop-p-ethyl at 50 g ha^{-1} + HW at 30 DAS Chhodavadia *et al.* (2014) [12] opined that total grasses, sedges and BLW were lower in green gram by application of PE Oxyfluorfen at 0.180 kg ha^{-1} + HW at 30 DAS. In green gram, total weed population was lower in PE application of Pendimethalin at 1000 g ha^{-1} *fb* HW at 30 DAS (Singh *et al.*, 2015) [69].

Balyan *et al.* (2016) stated that in rainfed black gram, lower weed density, dry weight and higher weed control efficiency was registered by inter cultivation at 15 DAS *fb* Imazethapyr at 100 g ha^{-1}. In irrigated green gram, at 15 DAS the lowest grass density was recorded with PE application of Pendimethalin at 1.0 kg ha^{-1} *fb* rotary weeding at 15-20 DAS (Muthuram *et al.*, 2017) [40]. At 30 DAS, lower weed dry weight (1.49 g m^{-2}) and higher WCE (96.69%) were recorded under PE application of Pendimethalin at 1.0 kg ha^{-1} *fb* manual weeding at 25-30 DAS in green gram (Patel *et al.*, 2018) [48]. PE application of Pendimethalin at 1 kg ha^{-1} + HW at 30 DAS resulted in lower weed density and higher WCE compared to weedy check at all stages of green gram (Mohammad Hasanain *et al.*, 2020) [35].

Effect of IWM on growth attributes

In *summer* green gram, the tallest plants were observed in Quizalofop-p-ethyl at 50 g ha^{-1} *fb* HW at 28 DAS (Kundu *et al.*, 2009) [27]. Patel *et al.* (2020) [49] noticed that in green gram higher plant dry weight was registered with EPOE application of Imazethapyr 100 g ha^{-1} *fb* Inter culturing + HW at 40 DAS. In green gram, higher plant height was observed in two HW and it was on par with Pendimethalin 0.45 kg ha^{-1} + HW at 4 WAS and Pendimethalin + Imazethapyr 0.45 kg ha^{-1} + HW at 4 WAS (Rukinderpreet Singh and Guriqbal Singh, 2020) [57].

Effect of IWM on yield attributes and yield

Application of PE Fluchloralin at 1.5 kg ha^{-1} + HW on 40 DAS registered higher grain yield of 872 kg ha^{-1} in green gram (Natarajan *et al.*, 2003) [44]. In green gram, the highest seed yield was found with PE Pendimethalin at 1.5 kg ha^{-1} *fb* HW at 30 DAS (Malik *et al.*, 2005) [31]. Khan *et al.* (2014) [23] opined that higher number of pods plant^{-1} (19) and seed yield (937 kg ha^{-1}) were recorded with glyphosate spraying on no tillage condition at 7 days before seeding + HW at 25 days after emergence in green gram. Balyan *et al.* (2016) noticed that inter culture operation at 15 DAS *fb* quizalofop-ethyl at 50 g ha^{-1} at 30 DAS registered highest number of pods plant^{-1}, seeds pod^{-1}, pod length and 1000 seed weight in black gram.

The green gram yield (839 kg ha^{-1}) was higher under application of PE Pendimethalin at 1.25 kg ha^{-1} + POE Imazethapyr at 100 g ha^{-1} (Narendra Kumar *et al.*, 2017) [43]. During *kharif*, higher grain yield was recorded with PE

application of Pendimethalin at 1.0 kg ha^{-1} *fb* POE Quizalofop ethyl at 50 g ha^{-1} in green gram (Patel *et al.*, 2018) [48]. Susmitha *et al.* (2019) [72] reported that higher yield was recorded under PE Pendimethalin + Imazethapyr at 1.0 kg ha^{-1} + POE Acifluorfen sodium + Clodinafop-propargyl at 165 + 80 g ha^{-1}.

Effect of weed control on nutrient uptake by crop

Maximum nutrient uptake was registered with weed free condition and it was on par with two HW and two inter culturing at 20 and 40 DAS in green gram (Chhodavadia *et al.*, 2011) [11]. Komal *et al.* (2015) [24] opined that PE Pendimethalin 0.75 kg ha^{-1} + HW on 30 DAS registered higher nutrient uptake (94.2, 12.1 and 91.6 kg NPK ha^{-1}) in green gram. Ready mix application of PE Pendimethalin + POE Imazethapyr at 0.75 kg ha^{-1} registered higher nutrient uptake in green gram (Anmol chugh *et al.*, 2017) [5].

Mousumi Dash and Basudev Behera (2018) [36] recorded the highest nutrient uptake (38.81, 6.91 and 42.47 kg NPK ha^{-1}) was noticed in application of PE Pendimethalin at 1.0 kg ha^{-1}. Poornima *et al.* (2018) [50] observed that in green gram, the highest nitrogen, phosphorus and potassium uptake was recorded in HW at 20 and 40 DAS. In green gram, higher nutrient uptake was registered in HW on 4 and 6 WAS (Rukinderpreet Singh and Guriqbal Singh, 2020) [57]. Umesh Kumar *et al.* (2021) [73] stated that higher N (24.73 kg ha^{-1}), P (4.83 kg ha^{-1}) and K (45.94 kg ha^{-1}) uptake was recorded in HW at 20 and 40 DAS in green gram.

Effect of weed control on nutrient removal by weeds

Gaganpreet Kaur *et al.* (2010) [18] observed that in green gram PE application of Pendimethalin at 0.75 kg ha^{-1} registered lower nutrient removal by weeds and it was on par with Chlorimuron-ethyl at 15 g ha^{-1}. Chhodavadia *et al.* (2011) [11] reported that unweeded check registered higher nutrient removal by weeds in green gram. Lower nutrient removal by weeds was observed with two HW and two inter culturing at 20 and 40 DAS in green gram (Chhodavadia *et al.*, 2014) [12]. Unweeded control registered maximum nutrient removal by weeds as noticed by Komal *et al.* (2015) [24]. In *summer* green gram, maximum nutrient removal by weeds was observed under weedy check (Anmol chugh *et al.*, 2017) [5]. Maximum nutrient removal by weeds was observed with weedy check in green gram (Om Prakash Shivran *et al.*, 2017) [45].

Verma *et al.* (2017) [77] stated that weedy check registered maximum nutrient removal by weeds (1.75, 0.24 and 2.75 kg NPK ha^{-1}) in green gram. Poornima *et al.* (2018) [50] found that PE application of Pendimethalin at 1000 g ha^{-1} *fb* POE Imazethapyr at 75 g ha^{-1} registered lower nutrient removal by weeds. In green gram, higher N, P and K removal were recorded in weedy check as against the lowest removal in PE Pendimethalin at 1 kg ha^{-1} + HW (30 DAS) which was observed by Mohammad Hasanain *et al.* (2020) [35]. Minimum nutrient removal was recorded in weed free plot (Kuldeep Singh *et al.*, 2021) [25].

Effect of weed management on economics

Application of POE Quizalofop-p-ethyl at 50 g ha^{-1} *fb* HW at 28 DAS registered higher BC ratio (2.26) (Kundu *et al.*, 2009) [27]. The highest net return and BC ratio were obtained by PE application of Pendimethalin at 2 lit ha^{-1} (Muhammad Sohail Khan *et al.*, 2011) [37]. In green gram, POE application of fenoxaprop-p-ethyl at 50 g ha^{-1} + Chlorimuron-ethyl at 4 g ha^{-1} registered higher BC ratio of 1.52 (Panch Ram Mirjha *et al.*, 2013) [46]. Chhodavadia *et al.* (2014) [12] recorded that higher BC ratio was obtained with application of PE Oxyflourfen at 0.18 kg ha^{-1} + HW at 30 DAS in green gram. Higher total variable cost (RS.34390 ha^{-1}), gross return (Rs.85612 ha^{-1}) and gross profit margin (Rs.51222 ha^{-1}) were recorded in PE Pendimethalin at 2 ml lit^{-1} of water in green gram (Shamima Aktar *et al.* 2015) [63]. Ramesh and Rathika (2015) [53] reported that higher net return was recorded with application of Imazethapyr at 50 g ha^{-1} + Quizalofop ethyl at 50 g ha^{-1} in black gram. Alam *et al.* (2016) [1] opined that higher gross return, net return and BC ratio were recorded with PE Oxadiargyl at 200 g ha^{-1} in green gram.

Muthuram *et al.* (2017) [40] noticed that higher BC ratio (2.44) was observed in green gram with PE application of Pendimethalin at 1.0 kg ha^{-1} *fb* EPOE Quizalofop ethyl and Imazethapyr at 50 g ha^{-1}. Leva *et al.* (2018) [29] stated that in green gram, PE Pendimethalin 1.0 kg ha^{-1} *fb* inter cultivation at 40 DAS registered the highest BC ratio. Guriqbal Singh *et al.* (2019) [19] stated that in green gram the highest BC ratio was recorded with PE application of Pendimethalin + Imazethapyr at 750 g ha^{-1}. Arvind Verma and Roshan Choudhary (2020) [7] stated that in green gram higher net return and BC ratio were obtained by ready mix POE application of Aciflourfen + Clodinafop at 370 g ha^{-1}. Application of PE Pendimethalin at 1.0 kg ha^{-1} + POE Imazethapyr at 50 g ha^{-1} registered higher net return and BC ratio in green gram (Ramesh and Rathika, 2020) [55]. In green gram, the highest net return and BC ratio were observed with application of PE Pendimethalin at 1.25 kg ha^{-1} + HW at 35 DAS (Mukherjee, 2021) [38].

Conclusion

Weeds create severe competition with green gram for sharing resources during early stages of crop growth. Manual weeding controls all type of weeds but during critical stages acute labour scarcity and increased labour wages made the farmers to move for alternate method of weed control like herbicide application. Pre emergence followed by post emergence application of herbicides is a viable option to control the weeds and enhancing the crop productivity compared to pre emergence alone, post emergence alone and manual weeding. Because pre emergence herbicides controls new flush of weeds and post emergence herbicides controls later emerging weeds. Hence, application of either pre emergence herbicides followed by one hand weeding or spraying of both pre emergence followed by post emergence herbicides are best practice for achieving efficient and economic weed control besides obtaining higher monetary returns in irrigated green gram considering the current scenario of labour scarcity.

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