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RESEARCH NOTE

Effect of herbicide mixtures on weeds and yield of summer groundnut

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ABSTRACT

Field experiment was carried during summer 2020 at Agronomy farm, B. A. College of Agriculture, Anand Agricultural University, Anand, Gujarat on loamy sand soil to study the effect of herbicide mixtures on weeds and yield of summer groundnut (*Arachis hypogaea* L.). The experiment was conducted in randomized block design with twelve treatments, replicated four times. Weed density decreased significantly with pre-emergence application (PE) of pendimethalin + oxyfluorfen (tank mix) 900 + 120 g/ha and intercultivation (IC) followed by (*fb*) hand weeding (HW) at 20 and 50 days after seeding (DAS), as compared to other treatments, which resulted in significant increase in growth and yield attributes *viz.*, periodical plant height (cm), plant dry biomass (g/plant), nodule dry weight (mg/plant), number of pods/ plant, pod yield (kg/ha), haulm yield (kg/ha), seed index (g), harvest index (%) and shelling percentage (%). Maximum net returns (Rs. 125485/ha) and B:C (4.94) was achieved with pendimethalin + oxyfluorfen 900 + 120 g/ha PE which was closely followed by IC *fb* HW at 20 and 50 DAS and early post-emergence application of fluazifop-p-butyl (11.1%) + fomesafen (11.1%) SL (pre-mix) 250 g/ha.

Keywords: Groundnut, Fluazifop-p-butyl + fomesafen, Herbicide, Pendimethalin + oxyfluorfen, Weed management

The major constraint limiting production of groundnut is inadequate weed management (Naim *et al.* 2010). In groundnut, less crop canopy during the first 6 weeks of growth favours strong competition with weeds causing significant reduction in yield (Shanwad *et al.* 2011). The extent of yield losses due to weeds range from 47% during the summer season to 62% during the *Kharif* season. In irrigated summer groundnut, average yield loss due to weed infestation was 89% (Giri *et al.* 1998). The heavy infestation of weeds during critical stage of crop necessaites theremoval of weeds either manually or chemically for attaining improved groundnut yield (Vora *et al.* 2019, Kundu *et al.* 2021).

The field experiment was conducted at the Agronomy Farm, B.A. College of Agriculture, Anand Agricultural University, Anand during summer season of the year 2020. The soil of the experimental field was loamy sand in texture having low in organic carbon, medium in available phosphorus and high in available potassium with 7.97 pH. The experiment was laid out in randomized block design with twelve treatments comparised of: pre-emergence application (PE) of pendimethalin (30%) EC + oxyfluorfen (23.5%) EC (tank mix) 900 + 120 g/ha, pendimethalin (30%) + imazethapyr (2%) EC (pre-mix) 900 + 60 g/ha PE, imazethapyr (35%) + imazamox (35%) WG (pre-mix) 70 g/ha PE, early post-emergence application (EPoE) of imazethapyr (35%) + imazamox (35%) WG (pre-mix) 70 g/ha, fluazifop-p-butyl (11.1%) w/w+ fomesafen (11.1%) w/w SL (pre-mix) 250 g/ha EPoE, post-emergence application (PoE) of fluazifop-p-butyl (11.1%) w/w + fomesafen (11.1%) w/w SL (pre-mix) 250 g/ha, propaquizafop (2.5%) + imazethapyr (3.75%) w/w ME (pre-mix) 125 g/ha EPoE, propaquizafop (2.5%) + imazethapyr (3.75%) w/w ME (pre-mix) 125 g/ha PoE, sodium acifluorfen (16.5%) + clodinafop-propargyl (8%) EC (pre-mix) 245 g/ha EPoE, sodium acifluorfen (16.5%) + clodinafop-propargyl (8%) EC (pre-mix) 245 g/ha PoE, intercultivation (IC) followed by (*fb*) hand weeding (HW) at 20 and 50 days after seeding (DAS) and weedy check replicated four times. Groundnut cv. GG 34 was sown on 30th January, 2020 keeping spacing of 30 cm between row by using seed rate of 120 kg/ha. The crop was harvested on 16th June, 2020. Herbicides were applied by using battery operated knapsack sprayer fitted with flat-fan nozzle by mixing in 500 litre of water/ha as per treatments. The crop was fertilized with recommended rate of fertilizer with 25 kg N and 50 kg P_2O_5/ha in the form of urea and single super phosphate, respectively as a basal dose. The rest of the recommended package of practices were adopted to raise the crop. Density and dry weight (biomass) of weeds were recorded from randomly selected four spots by using 0.25 m^2 iron quadrat from net plot through destructive sampling at 30, 60 DAS and at harvest. Other growth and yield

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attributing observation was also recorded from net plot area. Data on various observations during the experiment period was statistically analysed as per the standard procedure developed by Cochran and Cox (1957).

Effect on weeds

Among all the weed species observed in the experimental field, *Eleusine indica*, *Dactyloctenium aegyptium* and *Eragrostis major*, the monocots and *Digera arvensis* L., *Boerhaavia diffusa*, *Chenopodium album* and *Chenopodium murale*, the dicots were dominant and rest of the weed species were considered as other weeds.

Pendimethalin + oxyfluorfen (tank mix) 900 + 120 g/ha PE, pendimethalin + imazethapyr (pre-mix) 900 + 60 g/ha PE, fluazifop-p-butyl + fomesafen (pre-mix) 250 g/ha EPoE, propaquizafop + imazethapyr (pre-mix) 125 g/ha EPoE, sodium-acifluorfen + clodinafop-propargyl (pre-mix) 245 g/ha EPoE and IC *fb* HW at 20 and 50 DAS provided effective control and minimised the monocot and dicot weed density and biomass at 30 and 60 DAS. At 60 DAS, pendimethalin + oxyfluorfen (tank mix) 900 + 120 g/ha PE and IC *fb* HW at 20 and 50 DAS provided complete control of monocot and dicot weeds. Oxyfluorfen and pendimethalin mixture was very effective when applied prior to and at the time of weed seed germination against grasses and broad-leaved weeds, providing broad spectrum control of weed in grounnut.

The monocot and dicot weed density and biomass at harvest was significantly lower under IC *fb* HW at 20 and 50 DAS but it was at par with pendimethalin + oxyfluorfen EC (tank mix) 900 + 120 g/ha PE, fluazifop-p-butyl + fomesafen (pre-mix) 250 g/ha EPoE, pendimethalin + imazethapyr (pre-mix) 900 + 60 g/ha PE. Punia *et al.* (2017) observed the lowest weed density with imazethapyr + pendimethalin (ready mix) at 1000 g/ha in greengram.

Effect of crop

The growth attributes like plant height (cm) at 60 DAS and at harvest, plant dry biomass plant (g/ plant) and dry weight of nodules (mg/plant) were significantly affected by different weed management practices. Significantly higher plant height (45.29 cm) and plant dry biomass (14.22 g/plant)at harvest and nodule dry weight (65.75 g/plant) was recorded under IC *fb* HW at 20 and 50 DAS andit was statistically similar with pendimethalin + oxyfluorfen (tank mix) 900 + 120 g/ha PE at 45, 60 DAS and at harvest as reported by Patel *et al.* (2020). Similarly, Choudhary *et al.* (2017) also observed effective nodules/plant and dry weight under weed free treatment in groundnut.

Among the yield attributing characters, higher number of pods/plant (23.08), seed index (62.80 g), harvest index (41.46%), shelling percentage (66.31%) and pod yield (3058 kg/ha) wererecorded

Table 1. Density and biomass of monocot and dicot weeds as influenced by different treatments

Treatment	Weed density (no./ m^2)						Weed biomass(g/m^2)						WCE (%) at harvest
	Monocot			Dicot			Monocot			Dicot			
	30 DAS	60 DAS	At harvest	30 DAS	60 DAS	At harvest	30 DAS	60 DAS	At harvest	30 DAS	60 DAS	At harvest	
Pendimethalin + oxyfluorfen (tank mix) 900 + 120 g/ha PE	1.00^{e} (0.0)	1.00^{f} (0.0)	2.62^{f} (6.0)	1.00^{f} (0.0)	1.00^{e} (0.0)	2.62^{fg} (6.0)	1.00^{e} (0.0)	1.00^{d} (0.0)	4.74^{e} (21.9)	1.00^{f} (0.0)	1.00^{d} (0.0)	6.20^{d} (38.5)	90.52
Pendimethalin + imazethapyr (pre-mix) 900+60 g/ha PE	1.00^{e} (0.0)	2.12^{de} (4.0)	2.65^{ef} (7.0)	2.12^{e} (4.0)	5.46^{cd} (29.0)	3.15^{ef} (9.0)	1.00^{e} (0.0)	1.76^{d} (2.3)	4.85^{e} (27.92)	1.34^{e} (0.8)	3.67^{c} (12.6)	6.96^{d} (48.4)	88.02
Imazethapyr + imazamox (pre-mix) 70 g/ha PE	2.24^{d} (4.0)	3.30^{c} (10.0)	4.11^{d} (16.0)	3.73^{d} (13.0)	6.61^{abc} (43.0)	4.11^{cd} (16.0)	1.309^{d} (0.7)	3.29^{c} (9.9)	11.88^{cd} (140.52)	1.92^{d} (2.7)	6.99^{b} (48.4)	12.87^{bc} (164.8)	52.10
Imazethapyr + imazamox (pre-mix) 70 g/ha EPoE	2.62^{cd} (6.0)	3.80^{c} (14.0)	4.55^{cd} (20.0)	3.86^{d} (14.0)	6.68^{abc} (48.0)	4.46^{c} (19.0)	1.43^{cd} (1.1)	3.34^{c} (10.2)	14.05^{bc} (196.80)	1.98^{d} (2.9)	7.17^{b} (50.9)	13.10^{bc} (170.9)	42.31
Fluazifop-p-butyl + fomesafen (pre-mix) 250 g/ha EPoE	1.00^{e} (0.0)	1.81^{ef} (3.0)	2.62^{f} (6.0)	1.00^{f} (0.0)	1.00^{e} (0.0)	2.96^{efg} (8.0)	1.00^{e} (0.0)	1.62^{d} (2.0)	5.20^{e} (26.35)	1.00^{f} (0.0)	1.00^{d} (0.0)	7.17^{d} (52.6)	87.62
Fluazifop-p-butyl + fomesafen (pre-mix) 250 g/ha PoE	2.81^{c} (7.0)	5.07^{b} (25.0)	5.37^{bc} (28.0)	4.11^{cd} (16.0)	7.34^{ab} (53.0)	5.47^{b} (29.0)	1.49^{c} (1.2)	4.71^{b} (21.2)	14.95^{b} (222.87)	2.07^{cd} (3.3)	7.38^{b} (54.3)	13.61^{bc} (186.8)	35.73
Propaquizafop + imazethapyr (pre-mix) 125 g/ha EPoE	1.00^{e} (0.0)	3.11^{cd} (9.0)	3.68^{de} (13.0)	2.43^{e} (5.0)	5.88^{bcd} (34.0)	3.84^{cd} (14.0)	1.00^{e} (0.0)	3.02^{c} (8.2)	10.30^{d} (107.57)	1.60^{e} (1.6)	6.68^{b} (44.2)	11.01^{c} (125.0)	63.52
Propaquizafop + imazethapyr (pre-mix) 125 g/ha PoE	2.81^{c} (7.0)	5.28^{ab} (27.0)	5.81^{ab} (33.0)	5.28^{ab} (27.0)	7.37^{a} (54.0)	6.15^{a} (37.0)	1.50^{c} (1.2)	4.96^{b} (23.8)	15.77^{ad} (252.67)	2.57^{ab} (5.6)	7.49^{b} (56.3)	14.10^{ab} (225.1)	25.05
Sodium acifluorfen + clodinafop-propargyl (pre-mix) 245 g/ha EPoE	1.00^{e} (0.0)	1.78^{ef} (4.0)	2.82^{ef} (8.0)	2.81^{e} (7.0)	4.63^{d} (22.0)	3.45^{de} (11.0)	1.00^{e} (0.0)	1.90^{d} (5.1)	14.47^{bc} (210.48)	1.45^{e} (1.1)	6.47^{b} (41.0)	10.92^{c} (121.9)	47.86
Sodium acifluorfen + clodinafop-propargyl (pre-mix) 245 g/ha PoE	3.30^{b} (10.0)	5.36^{ab} (28.0)	5.99^{ab} (35.0)	4.68^{bc} (22.0)	7.56^{a} (57.0)	6.38^{a} (40.0)	1.66^{b} (1.8)	5.29^{ab} (27.0)	16.72^{ab} (280.73)	2.33^{bc} (4.6)	8.90^{a} (79.7)	15.15^{ab} (229.9)	19.89
IC *fb* HW at 20 and 50 DAS	1.00^{e} (0.0)	1.00^{f} (0.00)	2.43^{f} (5.0)	1.00^{f} (0.0)	1.00^{e} (0.0)	2.43^{g} (5.0)	1.00^{e} (0.0)	1.00^{d} (0.0)	7.09^{e} (49.39)	1.00^{f} (0.0)	1.00^{d} (0.0)	6.30^{d} (38.9)	86.15
Weedy check	3.99^{a} (15.0)	6.31^{a} (39.0)	6.85^{a} (46.0)	5.91^{a} (34.0)	8.02^{a} (64.0)	6.77^{a} (45.0)	2.74^{a} (6.5)	6.20^{a} (37.4)	18.53^{a} (348.59)	2.85^{a} (7.1)	10.13^{a} (101.8)	16.87^{a} (288.8)	-
LSD (p=0.05)	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	-

*PE: pre-emergence pplication, EPoE: early post-emergence pplication, PoE: post-emergence pplication, IC: intercultivation, *fb:* followed by, HW: hand weeding

Table 2. Growth, yield attributes and yield of summer groundnutas influenced by different treatments

Treatment	Plant height (cm)			Plant dry biomass (g/plant)			Nodule dry weight (mg/plant) At 45 DAS	No. of pods/plant	Seed index (g) (100 seed wt.)	Pod yield (kg/ha)	Net return (`/ha)	B:C
	30 DAS	60 DAS	At harvest	45 DAS	60 DAS	At harvest						
Pendimethalin + oxyfluorfen (tank mix) 900 + 120 g/ha PE	8.55	16.85^{c}	39.95^{bcd}	13.24^{ab}	16.33^{ab}	71.26^{b}	63.33^{ab}	22.93^{a}	62.07^{ab}	2979^{ab}	125485	4.94
Pendimethalin + imazethapyr (pre-mix) 900+60 g/ha PE	8.63	16.71^{c}	39.23^{cd}	11.46^{bcde}	14.79^{bcd}	67.43^{bc}	62.03^{abc}	21.58^{ab}	61.05^{ab}	2822^{abc}	116440	4.53
Imazethapyr + imazamox (pre-mix) 70 g/ha PE	8.55	16.30^{c}	39.36^{cd}	10.60^{def}	13.87^{cde}	61.26^{cde}	57.85^{bcd}	19.95^{b}	57.14^{bcd}	2513^{cde}	100971	4.12
Imazethapyr + imazamox (pre-mix) 70 g/ha EPoE	8.73	17.08^{c}	41.24^{abcd}	10.35^{def}	13.06^{def}	57.07^{def}	55.85^{cd}	17.40^{c}	54.36^{cde}	2397de	94723	3.92
Fluazifop-p-butyl + fomesafen (pre-mix) 250 g/ha EPoE	8.30	16.60^{c}	39.52^{cd}	12.77^{abc}	15.06^{b}	70.44^{b}	62.23^{abc}	21.93^{ab}	60.69^{ab}	2854^{abc}	119545	4.79
Fluazifop-p-butyl + fomesafen (pre-mix) 250 g/ha PoE	8.35	19.12^{b}	42.36^{abcd}	9.90^{def}	12.61^{ef}	56.82^{ef}	54.88^{d}	17.40^{c}	54.00^{cde}	2169^{e}	83477	3.65
Propaquizafop + imazethapyr (pre-mix) 125 g/ha EPoE	8.55	16.55^{c}	39.40^{cd}	10.91^{cdef}	14.31^{cde}	62.05^{cde}	59.87^{abcd}	20.23^{b}	58.39^{abc}	2538^{cde}	102356	4.19
Propaquizafop + imazethapyr (pre-mix) 125 g/ha PoE	8.70	19.91^{b}	42.88^{abc}	9.56^{efg}	12.77^{ef}	55.01^{f}	54.84^{d}	12.53^{d}	52.35^{de}	1673^{f}	56742	2.77
Sodium acifluorfen + clodinafop-propargyl (pre-mix) 245 g/ha EPoE	8.70	17.15^{c}	38.20^{d}	11.58^{bcd}	14.49^{bcde}	63.39^{cd}	60.65^{abcd}	20.75^{b}	59.21^{abc}	2602^{bcd}	105179	4.23
Sodium acifluorfen + clodinafop-propargyl (pre-mix) 245 g/ha PoE	8.80	20.40^{b}	43.83^{ab}	9.44^{fg}	10.96^{f}	51.82^{f}	54.65^{d}	11.38^{d}	52.09^{de}	1704^{f}	57765	2.77
IC *fb* HW at 20 and 50 DAS	8.75	16.65^{c}	40.74^{bcd}	14.22^{a}	17.87^{a}	75.92^{a}	65.75^{a}	23.08^{a}	62.80^{a}	3058^{a}	124634	4.38
Weedy check	8.80	21.50^{a}	45.29^{a}	8.03^{g}	9.11^{g}	42.12^{g}	54.30^{d}	8.53^{e}	50.65^{e}	991^{g}	23976	1.81
LSD (p=0.05)	NS	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	-	-

*PE: pre-emergence pplication, EPoE: early post-emergence pplication, PoE: post-emergence pplication, IC: intercultivation, *fb:* followed by, HW: hand weeding

underIC *fb* HW at 20 and 50 DAS which was closely followed by pendimethalin + oxyfluorfen (tank mix) 900 + 120 g/ha PE and fluazifop-p-butyl + fomesafen (pre-mix) 250 g/ha EPoE. Higher pod yield might be due to lessergrowth of weeds as evident from the weed density and biomass. Mehriya *et al*. (2021) also obtained higher pod yield under hand weeding at 20 and 40 DAS.

The economic analysis revealed that maximum net returns (₹125485/ha) and B:C (4.94) was achieved with pendimethalin + oxyfluorfen (tank mix) 900 + 120 g/ha PE followed by fluazifop-p-butyl + fomesafen (pre-mix) 250 g/ha EPoE and IC *fb* HW at 20 and 50 DAS with B:C of 4.79 and 4.38, respectively.

It can be concluded that interculturing and hand weeding at 20 and 50 DAS effectively control the weeds, but it is the laborious, time consuming and costlier method of weed control. Hence, under paucity of labour, pendimethalin + oxyfluorfen (tank mix) 900 + 120 g/ha PE could be used for effective weed management and obtaining higher pod yield of summer groundnut with net return and benefit cost ratio.

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