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Residual Effect of Nitrogen and Weed Management Practices in Maize on Succeeding Groundnut

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ABSTRACT

Background: Cereal-legume cropping system is considered to be one of the better alternatives for sustaining soil fertility and increasing the yield. At present maize-groundnut cropping system is gaining importance under both rainfed and irrigated situations. Maize, being an exhaustive and weed-sensitive crop, is supplied with large doses of fertilizers and new herbicide molecules.Since maize is exhaustive and weed sensitive crop, there was a usage of excessive fertilizers and new herbicides. There is a need to assess the carry over effect of fertilizers and new generation herbicides in leguminous crops like groundnut.

Methods: The experiment was conducted during two consecutive *rabi* seasons of 2019-20 and 2020-21 on sandy loam soils of S.V. Agricultural College, Tirupati andhra Pradesh. Maize hybrid DHM -117 was sown and maintained with general cultivation practices except for nitrogen and weed management methods was raised after harvest of maize in undisturbed layout to study the residual effect of different nitrogen and weed management practices imposed in maize.

Result: Residual effect of nitrogen and weed management practices imposed in preceding maize did not exert any significant influence on germination percentage, phytotoxicity and SPAD chlorophyll meter reading (SCMR) values but efficacy of herbicide residue found to be significant with weed management practices. Growth parameters, yield attributes pod yield, haulm yield and economics were higher in groundnut with brown manuring, which was however, in parity with hand weeding twice at 15 and 30 DAS, pre emergence application of atrazine 1.0 kg ha^{-1} *fb* post emergence application of topramezone 30 g ha^{-1} and pre emergence application of atrazine 1.0 kg ha^{-1} *fb* post emergence application of tembotrione 120 g ha^{-1} and lower with unweeded check and it was remained in parity with application of parthenium water extract15 lha^{-1} twice at 15 and 30 DAS, application of sunflower water extract 15 lha^{-1} twice at 15 and 30 DAS, pre emergence application of atrazine 1.0 kg ha^{-1} *fb* post emergence application of parthenium water extract 15 lha^{-1} and pre emergence application of atrazine 1.0 kg ha^{-1} *fb* post emergence application of sunflower water extract 15 lha^{-1} in the order of ascent. None of their interaction effects were found to be significant during both the years of study and in pooled mean.

Key words: Groundnut, Maize, Nitrogen, Residual effect, Weed.

INTRODUCTION

Maize is an exhaustive crop and highly responsive to nitrogen fertilizers. Farmers usually apply excessive doses of chemical fertilizers for producing higher yield Application of imbalanced and excessive nutrients led to decline in nutrient use efficiency making fertilizer consumption uneconomical and producing adverse effects on atmosphere (Aulakh and Adhya, 2005). Generally, fertilizer dose is recommended on the basis of individual crop response. Crops grown in fixed cropping sequence behave differently than their respective sole crops. However, the current system of fertilizer recommendation ignores the carry over effects of the fertilizers applied to the preceding crops. Nutrients applied to the preceding crops benefit the succeeding crops to a great extent (Nawale *et al*., 2007). Hence, it is essential that the cultivators are made aware of the possible carry over effects under sequential cropping.

Cereal-legume cropping system is considered to be one of the better alternatives for sustaining soil fertility and increasing the yield of cereal crops besides greater productivity per unit time and space and higher net returns of the system. Intensive cultivation through multiple cropping with proper planning in a sustainable way will help in increasing the food grain production for meeting the future demand and requirement. At present maize-groundnut cropping system is gaining importance under both rainfed and irrigated situations. Since maize is an exhaustive and weed sensitive crop, it removes lot of nutrients from soil

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(Ratnam *et al.,* 2018). The succeeding groundnut builds up the soil nitrogen symbiotically and its leaf senescence character also improves the soil organic matter.

Saikia *et al.* (2000) reported that atrazine content in sandy loam soil at different intervals showed initial slow rate of loss of atrazine in soil up to 20 days and there after faster dissipation and at maize harvest (90 days) no detectable residue was left to injure the succeeding wheat, linseed and lentil. The total weed population was drastically reduced by the additive effect of the residual atrazine (0.25 to 1.0 kg ha^{-1}) and pendimethalin (0.75 kg ha^{-1}) in the succeeding soybean crop in maize-soybean sequential cropping system. Reddy *et al*., (2004) observed that pre-emergence atrazine and pre-emergence pendimethalin (0.5 kg ha^{-1}) applied to maize did not leave any significant amount of residues to adversely affect the germination and yield of succeeding groundnut But the information on the residual effect of herbicides (topramezone, tembotrione and 2,4 D) applied in maize on succeeding groundnut is meager. There is a need to assess the influence of new generation herbicides under maize-groundnut cropping system. Hence, residual effect of nitrogen and weed management practices applied in maize on succeeding groundnut was studied in the agro climatic zone of Andhra Pradesh, India.

MATERIALS AND METHODS

The experiment was conducted during two consecutive *rabi* seasons of 2019-20 and 2020-21 on sandy loam soils of S.V. Agricultural College, Tirupati, Andhra Pradesh, which is geographically situated at 13.5°N latitude 79.5°E longitude and at an altitude of 182.9 m above mean sea level in the Southern Agro-climatic Zone of Andhra Pradesh. The soil was sandy loam in texture, neutral in soil reaction (6.85), low in organic carbon (0.28 %) and available nitrogen (113.4 kg ha^{-1}), medium in available phosphorus (26.4 kg ha^{-1}) and potassium (180.9 kg ha^{-1}). The field experiment was laid out in a split plot design with three replications. The treatments comprised of four nitrogen management practices *viz*., control, recommended dose of fertilizer (180 kg ha^{-1}), green seeker directed N application (201.7 kg ha^{-1}) and soil test based fertilizer application (234 kg ha^{-1}) assigned to main plots and nine weed management practices *viz*., unweeded check, hand weeding twice at 15 and 30 DAS, pre-emergence application of atrazine 1.0 kg/ha *fb* post-emergence application of topramezone 30 g/ha, pre-emergence application of atrazine 1.0 kg/ha *fb* post-emergence application of tembotrione 120 g/ha, application of parthenium water extract 15 L/ha twice at 15 and 30 DAS, application of sunflower water extract 15 L/ha twice at 15 and 30 DAS, pre-emergence application of atrazine 1.0 kg/ha *fb* post-emergence application of parthenium water extract 15 L/ha, pre-emergence application of atrazine 1.0 kg/ha *fb* post-emergence application of sunflower water extract 15 L/ha and brown manuring. In brown manuring treatmental plots (W_9), sesbania 15 kg ha^{-1} was sown in between rows of maize and it was knocked down with 2,4-D 1.0 kg ha^{-1} at 35 DAS. Maize hybrid DHM -117 was sown and maintained with all general cultivation practices except for nitrogen and weed management methods.

Groundnut was raised after harvest of maize in undisturbed layout to study the residual effect of different nitrogen and weed management practices imposed in maize. Groundnut variety Dharani was sown at a spacing of spacing 22.5 cm × 10 cm in the first fortnight of December and harvested in second fortnight of March during both the years. Data recorded on different parameters of groundnut were statistically analyzed following the analysis of variance for split plot design as suggested by Panse and Sukhatme (1985).

Phytotoxicity rating on the groundnut crop was done at 10^{th} and 15^{th} day after sowing, as per the method suggested by Singh and Rao (1976). Level of greenness was measured with Chlorophyll meter (model SPAD 502 of Minolta company, Japan). SPAD Chlorophyll Meter Readings (SCMR) were recorded by following the method of Turner and Jund (1991) at 15 DAS. SCMR data were recorded on 3^{rd} leaf from top of each representative plant, between 8.00 A.M. and 11.00 A.M. of the day. A mean of 15 readings from 5 representative plants per plot was taken. Efficacy of herbicide residue was calculated based on dry biomass weight of groundnut (Simarmata *et al.,* 2018).

$$EHR = \frac{DBWt - DBWc}{DBWc} \times 100$$

Where:
EHR= Efficacy of herbicide residue.
DBWt= Dry biomass weight of treated seedling.
DBWc= Dry biomass weight of control or untreated seedling.

RESULTS AND DISCUSSION

Phytotoxic studies of groundnut

Nitrogen management practices imposed in preceding maize did not exert any significant influence on germination percentage, phytotoxicity, SPAD chlorophyll meter reading (SCMR) values and efficacy of herbicide in groundnut (Table 1).

Residual effect of weed management practices imposed in preceding maize was found to be non significant on germination percentage in groundnut, phytotoxicity and SPAD chlorophyll meter reading (SCMR) values but efficacy of herbicide residue found to be significant. The results obtained in this study are in line with the findings of Chand *et al.* (2014) and Sathyapriya and Chinnusamy (2020).

Significantly higher efficacy of herbicide residue was observed with brown manuring (W_9), which was however, comparable with pre emergence application of atrazine 1.0 kg ha^{-1} *fb* post emergence application of topramezone 30 g ha^{-1} (W_3) and pre emergence application of atrazine 1.0 kg ha^{-1} *fb* post emergence application of tembotrione 120 g ha^{-1} (W_4) during both the years of study. Higher weed control efficiency in the these treatments in preceding maize might have led to lower density and dry weight of weeds in

Table 1: Phytotoxic studies and growth parameters of groundnut as influenced by nitrogen and weed management practices in preceding maize.

Treatments	Germination percentage			SCMR values at 15 DAS			Efficacy of herbicide residue (%) at 15 DAS			Plant height (cm) at harvest			Dry matter production (kg ha^{-1}) at harvest		
	2019-20	2020-21	Pooled	2019-20	2020-21	Pooled	2019-20	2020-21	Pooled	2019-20	2020-21	Pooled	2019-20	2020-21	Pooled
Nitrogen management practices															
N_1: Control	92.1	90.3	91.2	36.6	35.2	35.9	12.91	13.05	12.98	33.5	32.5	33	6382	6034	6208
N_2: Recommended dose of fertilizer	92.4	90.6	91.5	37.7	36.3	37.0	13.51	13.62	13.57	34.9	34.1	34.5	6559	6221	6390
N_3: Green seeker directed N application	92.8	90.0	91.4	39.2	37.7	38.4	13.63	13.74	13.69	37.4	36.5	36.9	6887	6523	6705
N_4: Soil test based fertilizer application	92.6	90.5	91.6	38.6	37.1	37.9	13.65	13.66	13.66	36.2	35.1	35.6	6701	6366	6533
SEm ±	1.21	1.18	1.17	1.10	1.07	1.09	0.43	0.39	0.40	0.95	1.00	0.96	125.5	149.1	120.2
CD (P = 0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Weed management practices															
W_1: Unweeded check	91.9	90.0	91.0	37.2	35.8	36.5	0.00	0.00	0.00	31.4	30.3	30.9	6005	5545	5775
W_2: Hand weeding twice at 15 and 30 DAS	93.2	91.0	92.1	38.4	36.9	37.7	0.00	0.00	0.00	39.6	38.7	39.1	7260	6912	7086
W_3: PE application of atrazine @ 1.0 kg ha^{-1} *fb* PoE application of topramezone @ 30 g ha^{-1}	92.9	90.7	91.8	38.3	36.8	37.6	23.86	23.85	23.86	38.9	38.0	38.4	7188	6821	7005
W_4: PE application of atrazine @ 1.0 kg ha^{-1} *fb* PoE application of tembotrione @ 120 g ha^{-1}	92.1	90.9	91.5	38.1	36.6	37.4	22.96	23.05	23.00	38.0	37.1	37.6	7066	6750	6908
W_5: Application of parthenium water extract @ 15 l ha^{-1} twice at 15 and 30 DAS	92.0	89.9	91.0	37.4	36.0	36.7	11.41	11.59	11.51	32.3	31.2	31.7	6099	5790	5945
W_6: Application of sunflower water extract @ 15 l ha^{-1} twice at 15 and 30 DAS	92.1	90.0	91.1	37.5	36.1	36.8	10.42	10.40	10.41	32.6	31.5	32.1	6138	5818	5978
W_7: PE application of atrazine @ 1.0 kg ha^{-1} *fb* PoE application of parthenium water extract @ 15 l ha^{-1}	93.1	89.8	91.5	37.8	36.3	37.1	11.96	12.33	12.15	32.9	31.8	32.4	6233	5913	6073
W_8: PE application of atrazine @ 1.0 kg ha^{-1} *fb* PoE application of sunflower water extract @ 15 l ha^{-1}	92.1	90.0	91.1	38.0	36.5	37.3	12.59	12.55	12.57	33.5	33.3	33.4	6299	5988	6143
W_9: Brown manuring	92.9	90.7	91.8	39.4	37.9	38.6	25.58	25.38	25.48	40.0	38.9	39.5	7404	7040	7222
SEm ±	2.21	1.83	2.12	1.10	1.06	1.07	0.820	0.791	0.801	1.22	1.02	1.22	137.0	142.8	124.9
CD (P = 0.05)	NS	NS	NS	NS	NS	NS	2.32	2.28	2.27	3.5	3.1	3.4	387	403	353
Interaction															
N at W															
SEm ±	2.01	2.23	2.02	2.21	2.13	2.17	1.640	1.563	1.602	2.45	2.43	2.44	298.8	311.2	272.3
CD (P = 0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
W at N															
SEm ±	2.89	3.10	3.19	3.22	3.10	3.16	1.320	1.231	1.276	2.80	2.95	2.83	338.0	398.6	322.9
CD (P = 0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

Table 2: Yield attributes of groundnut as influenced by nitrogen and weed management practices in preceding maize.

Treatments	Number of pods plant^{-1}			Number of filled pods plant^{-1}			Hundred pod weight (g)			Hundred kernel weight (g)			Shelling percentage (%)		
	2019-20	2020-21	Pooled	2019-20	2020-21	Pooled	2019-20	2020-21	Pooled	2019-20	2020-21	Pooled	2019-20	2020-21	Pooled
Nitrogen management practices															
N_1: Control	14.5	12.4	13.4	9.5	8.2	8.8	130	123	127	43.3	42.8	43.1	68	67	68
N_2: Recommended dose of fertilizer	14.9	13.0	14.0	9.8	8.8	9.3	135	126	131	44.7	44.7	44.7	73	72	73
N_3: Green seeker directed N application	15.7	13.8	14.8	10.6	9.7	10.1	142	135	139	46.6	45.8	46.2	75	74	74
N_4: Soil test based fertilizer application	15.5	13.6	14.5	10.3	9.6	9.9	139	134	136	45.5	44.7	45.1	74	73	73
SEm ±	0.38	0.40	0.35	0.27	0.28	0.27	3.9	3.8	3.1	1.18	1.21	1.04	1.7	1.8	1.7
CD (P = 0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Weed management practices															
W_1: Unweeded check	13.3	11.1	12.3	8.4	7.3	7.8	126.2	115.8	121.1	40.4	40.1	40.3	70	69	70
W_2: Hand weeding twice at 15 and 30 DAS	16.3	14.5	15.4	11.8	11	11.3	144.2	138.8	142.1	48.4	47.8	48.2	75	74	75
W_3: PE application of atrazine @ 1.0 kg ha^{-1} *fb* PoE application of topramezone @ 30 g ha^{-1}	16.1	14.2	15.2	11.4	10.5	10.8	144.2	137.8	141.1	48.1	47.6	47.9	75	74	74
W_4: PE application of atrazine @ 1.0 kg ha^{-1} *fb* PoE application of tembotrione @ 120 g ha^{-1}	16.2	14.3	15.3	11.4	10.4	10.8	144.2	137.8	141.1	47.9	47.5	47.8	75	74	75
W_5: Application of parthenium water extract @ 15 l ha^{-1} twice at 15 and 30 DAS	14.1	12	13.1	8.8	7.7	8.1	130.2	122.8	127.1	42.4	41.9	42.2	70	69	70
W_6: Application of sunflower water extract @ 15 l ha^{-1} twice at 15 and 30 DAS	14.2	12.1	13.2	8.9	7.9	8.3	131.2	123.8	127.1	42.7	42.1	42.5	70	69	70
W_7: PE application of atrazine @ 1.0 kg ha^{-1} *fb* PoE application of parthenium water extract @ 15 l ha^{-1}	14.5	12.4	13.5	9.1	8.1	8.5	131.2	123.8	128.1	43.1	42.5	42.9	70	69	70
W_8: PE application of atrazine @ 1.0 kg ha^{-1} *fb* PoE application of sunflower water extract @ 15 l ha^{-1}	14.5	12.5	13.6	9.1	8	8.4	131.2	123.8	128.1	43.2	42.8	43.1	70	69	70
W_9: Brown manuring	17.3	15.4	16.4	12	11.2	11.5	146.2	140.8	143.1	48.6	47.9	48.3	76	75	75
SEm ±	0.49	0.51	0.45	0.31	0.30	0.28	4.0	4.0	3.4	1.64	1.71	1.28	1.4	2.1	2.1
CD (P = 0.05)	1.4	1.4	1.3	0.9	0.9	0.8	11	12	10	4.4	4.6	3.6	NS	NS	NS

Table 2: Continue...

Table 2: Continue...

Interaction														
N at W														
SEm ±	0.98	1.01	0.90	0.63	0.61	0.55	8.0	7.8	6.8	3.27	3.42	2.57	4.2	4.1	4.2
CD (P = 0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
SEm ±	1.12	1.18	1.04	0.78	0.97	0.78	11.4	11.55	8.9	3.42	3.51	3.06	5.2	5.1	5.1
CD (P = 0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

the succeeding groundnut, which favored the crop to accumulate higher dry matter. Pre emergence application of atrazine 1.0 kg ha^{-1} *fb* post emergence application of sunflower water extract 15 l ha^{-1} (W_8), pre emergence application of atrazine 1.0 kg ha^{-1} *fb* post emergence application of parthenium water extract 15 l ha^{-1} (W_7), application of sunflower water extract 15 l ha^{-1} twice at 15 and 30 DAS (W_6) and application of parthenium water extract 15 l ha^{-1} twice at 15 and 30 DAS (W_5) were in parity with one another in registering lower efficacy of herbicide residue during both the years of study as well as in pooled mean.

Growth parameters, yield attributes and yield

Nitrogen management practices imposed in preceding maize did not exert any significant influence on yield attributes of groundnut (number of pods $plant^{-1}$, number of filled pods $plant^{-1}$, hundred pod weight, hundred kernel weight and shelling percentage) and yield (Table 1, 2 and 3).

Different weed management practices performed in preceding maize exerted remarkable influence on number of pods $plant^{-1}$, number of filled pods $plant^{-1}$, hundred pod weight and hundred kernel weight, pod yield but shelling percentage was found to be non significant. Similar trend was observed during both the years of study, including pooled mean.

Higher number of pods $plant^{-1}$, number of filled pods $plant^{-1}$, hundred pod weight, hundred kernel weight pod yield were noticed with brown manuring (W_9), which was however, at par with hand weeding twice at 15 and 30 DAS (W_2), pre emergence application of atrazine 1.0 kg ha^{-1} *fb* post emergence application of topramezone 30 g ha^{-1} (W_3) and pre emergence application of atrazine 1.0 kg ha^{-1} *fb* post emergence application of tembotrione 120 g ha^{-1} (W_4). This might be due to reduced crop weed competition in succeeding groundnut that facilitated better partitioning of photosynthates leading to better pod development and filling which in turn led to higher yield. Similar observations were reported by Singh *et al.* (2012) in mustard, Nazreen *et al.* (2018) and Rani *et al.* (2019) in maize.

Economics

Gross returns, net returns and benefit-cost ratio of groundnut was considerably altered by weed management practices followed in preceding maize as presented in Table 3. Nitrogen management practices in preceding maize did not exert any significant influence on economics of groundnut. The interaction effect was not significant.

Among the weed management practices tested, gross returns, net returns and benefit-cost ratio of groundnut followed similar trend during both the years of study and as well as in pooled mean. Brown manuring (W_9) registered higher gross returns, net returns and benefit-cost ratio of groundnut, which was however, at par with hand weeding twice at 15 and 30 DAS (W_2), pre emergence application of atrazine 1.0 kg ha^{-1} *fb* post emergence application of topramezone 30 g ha^{-1} (W_3) and pre emergence application of atrazine 1.0 kg ha^{-1} *fb* post emergence application of

Table 3: Yield and economics of groundnut as influenced by nitrogen and weed management practices in preceding maize.

Treatments	Pod yield (kg ha^{-1})			Haulm yield (kg ha^{-1})			Gross returns (` ha^{-1})			Net returns (` ha^{-1})			Benefit-cost ratio		
	2019-20	2020-21	Pooled	2019-20	2020-21	Pooled	2019-20	2020-21	Pooled	2019-20	2020-21	Pooled	2019-20	2020-21	Pooled
Nitrogen management practices															
N_1: Control	2454	2276	2365	3444	3365	3404	101604	94405	98004	58382	52615	55499	2.35	2.26	2.31
N_2: Recommended dose of fertilizer	2523	2343	2433	3510	3442	3476	104430	97162	100796	61208	55372	58291	2.42	2.33	2.37
N_3: Green seeker directed N application	2699	2497	2598	3656	3583	3619	111616	103463	107539	68394	61673	65034	2.58	2.48	2.53
N_4: Soil test based fertilizer application	2618	2425	2522	3555	3502	3528	108275	100502	104408	65053	58712	61903	2.51	2.40	2.46
SEm ±	77.8	70.6	61.8	65.8	65.2	71.0	3101.1	2868.4	2486.4	3101.1	2868.4	2486.4	0.06	0.06	0.05
CD (P = 0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Weed management practices															
W_1: Unweeded check	2214	2045	2130	3286	3092	3188	91846	84892	88388	48624	43102	45883	2.12	2.03	2.08
W_2: Hand weeding twice at 15 and 30 DAS	2934	2737	2836	3796	3734	3764	121156	113214	117204	77934	71424	74699	2.80	2.71	2.76
W_3: PE application of atrazine @ 1.0 kg ha^{-1} *fb* PoE application of topramezone @ 30 g ha^{-1}	2915	2724	2820	3745	3660	3702	120345	112620	116502	77123	70830	73997	2.78	2.69	2.74
W_4: PE application of atrazine @ 1.0 kg ha^{-1} *fb* PoE application tembotrione @ 120 g ha^{-1}	2857	2665	2762	3684	3648	3665	117964	110248	114145	74742	68458	71640	2.73	2.64	2.69
W_5: Application of parthenium water extract @ 15 l ha^{-1} twice at 15 and 30 DAS	2265	2073	2170	3328	3298	3312	93928	86218	90112	50706	44428	47607	2.17	2.06	2.12
W_6: Application of sunflower water extract @ 15 l ha^{-1} twice at 15 and 30 DAS	2288	2100	2195	3342	3299	3320	94862	87299	91120	51640	45509	48615	2.19	2.09	2.14
W_7: PE application of atrazine @ 1.0 kg ha^{-1} *fb* PoE application of parthenium water extract @ 15 l ha^{-1}	2323	2135	2230	3399	3356	3376	96319	88756	92576	53097	46966	50071	2.23	2.12	2.18
W_8: PE application of atrazine @ 1.0 kg ha^{-1} *fb* PoE application of sunflower water extract @ 15 l ha^{-1}	2368	2180	2275	3419	3384	3401	98139	90584	94401	54917	48794	51896	2.27	2.17	2.22
W_9: Brown manuring	2994	2806	2901	3876	3790	3832	123636	116030	119872	80414	74240	77367	2.86	2.78	2.82

Table 3: Continue...

Table 3: Continue...

SEm ±	95.7	82.9	75.9	81.4	89.3	88.3	3820.8	3318.3	3033.4	3820.8	3318.3	3033.4	0.08	0.07	0.06
CD (P = 0.05)	270	234	253	230	252	246	10795	9375	8570	10795	9375	8570	0.2	0.2	0.2
Interaction															
N at W															
SEm ±	191.2	165.8	151.8	162.9	178.5	1736.6	7641.7	6636.5	6066.9	7641.7	6636.5	6066.9	0.13	0.11	0.12
CD (P = 0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
W at N															
SEm ±	229.2	207.2	182.1	194.0	193.9	167.4	9133.6	8409.2	7317.6	9133.6	8409.2	7317.6	0.22	0.24	0.23
CD (P = 0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

tembotrione 120 g ha^{-1} (W_4). This may be attributed to higher pod yield due to reduced weed growth. Similar findings were reported by Mundra (2000) and Rani (2020).

Significantly lower gross returns, net returns and benefit-cost ratio of groundnut were noticed with weedy check (W_1) and it was at par with application of parthenium water extract 15 l ha^{-1} twice at 15 and 30 DAS (W_5), application of sunflower water extract 15 l ha^{-1} twice at 15 and 30 DAS (W_6), pre emergence application of atrazine 1.0 kg ha^{-1} *fb* post emergence application of parthenium water extract 15 l ha^{-1} (W_7) and pre emergence application of atrazine 1.0 kg ha^{-1} *fb* post emergence application of sunflower water extract 15 l ha^{-1} (W_8) in the order of ascent. This might be attributed to low yields of groundnut due to severe crop weed competition.

CONCLUSION

Nitrogen management practices adopted in preceding maize did not exert any significant influence on the performance of succeeding groundnut. While, brown manuring or two hand weedings or sequential application of pre and post emergence herbicides applied in preceding maize were found to be effective and economic practices for realizing higher yields and net returns in succeeding groundnut. None of their interaction effects were found to be significant during both the years of study and in pooled mean.

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Conflict of interest

All the authors are declared the there is no conflict of interest for publication and all are willing to publish the research findings.

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