Integrated effecte of chlorusulfuron , Nitrogen fertilizer, and varieties on striga management in sorghum.

Abstract

Field experiment was conducted during the cropping seasons of 2017/2018 main growing season in the Western Tigray to evaluate the effect of herbicide rates, N fertilizer level, and sorghum varieties on striga control. Split-split plot design was used and replicated thrice. The experiment comprised of four N fertilizer levels in main plot (control (0kg/ha, 23, 46 and 69kg/ha), four herbicide rates in sub-plot(o,10,15 and 20 gm/ha) and three varieties(Birhan,Deber and Wediaker) in sub-sub plot under naturally S. hermonthica infested area. Striga counts and striga growth parameters were collected. Results showed that days to first flowering, striga count per sorghum plant, stand counts of striga at 45DAP, 65 DAP and 85DAP per m^{-2}, branch number per plant, plant height and biomass of striga were significantly (P<0.01) affected with the application of N fertilizer, herbicide rates and varieties. Generally an integrated approach was found to be the best method to control striga.

Key words: striga hermonthica, Urea- Nitrogen fertilizer, herbicide, Varieties

1. Introduction

Striga hermonthica (Del.) Benth is an obligate root parasite that is indigenous to Africa and causes severe losses in most cultivated cereal crops in the continent. Incidence and severity of striga hermonthica insfection is particularly high in the Savannas of West Africa on sorghum, pearli millet and maize [1]. Controlling of striga hermonthica a massive assignment considering the seed production capacity of 10,000-100,000 seeds/plant which remains viable in the soil for many years till getting favorable conditions to initiate germination [2] and, their intimate physiological interaction with their host plants [3], the damage of the weed causes to crop before emergence and its ability to thrive best in poor soil fertility which is a special characteristics of the farm land of the poor farmers in Africa in general and Northern Ethiopia in particular is the most important characteristics of this parasite weed. Striga infestation is the outcome of continuous growing of striga susceptible cultivars, mono cropping of cereals which host the parasite and reducing soil fertility which weakens the host

plant to *Striga* attack [4]. Thus, the type of crop cultivars grown has a direct influence on *Striga* infestation. *Striga* susceptible varieties encourage a good growth of the pest, allowing for more production of seeds.

Due to the complicated nature of the parasitic weed (striga hormontheica) various control methods have been practiced for the control of *S. hermonthica*, but no stable and achievable results have been achieved. Such control measures include hand weeding, intercropping, crop rotation, trap cropping, nitrogen fertilizer, use of resistant or tolerant crop varieties biological control and integrated control. Single technology is not completely effective at controlling striga or containing its spread, efforts to integrate control options developed in different disciplines have been shown to be highly effective at reducing damage by the parasite [5 and 6]. So, this study was designed to test the integrated approach of striga management options using herbicide, variety, and N fertilizer for controlling striga.

2. Material and Methods

2.1 Experimental location

The field experiment was conducted in 2017 growing season at Humera Agricultural Research Center located in Kafta Humera District, Western Zone of Tigray Regional State, Ethiopia. The center is about 1372 km away from Addis Ababa and 600 km west of Mekelle, which is the capital city of Tigray Regional State. It is located at 14°15' N latitude and 36°37' E longitude with an average altitude of 609 meters above sea level.

2.2 Experimental design and Treatments

The experimental design used was laid out in split-split plot design with three replications. There were a total of forty eight treatment combinations in this experiment. The treatments were applied indiscriminately to each experimental plot of each replication (Gomez and Gomez, 1984). The three factors were N fertilizer levels, herbicide rates, and sorghum varieties (Table: 1).

Table 1: Main, Sub-plot, and sub-sub plot treatments used in the experiment

Treatments	Treatment levels
Nitrogen levels (main plot)	N0 (0 kg N ha^{-1})
	N1 (23 kg N ha^{-1})
	N2 (46 kg N ha^{-1})

	N3 (69 kg N ha^{-1})
Herbicide rates (sub-plot)	C0 (0gm ha^{-1})
	C1 (10 gm ha^{-1})
	C2 (15 gm ha^{-1})
	C3 (20 gm ha^{-1})
Varieties (sub-sub plot)	V1 (Brihan resistance variety)
	V2 (Deber local variety)
	V3 (Wediaker local variety)

NB: - N in the form of urea

Table 2: Combination of treatment and code of the treatment

Trt #	Combination of treatment	Code of treatment	Trt #	combination of treatment	code of treatment
1	0kg N ha^{-1}, 15g Cl ha^{-1} and Birhan	N0C2V1	25	46kg N ha^{-1}, 10g Cl ha^{-1} and Birhan	N2C1V1
2	0kg N ha^{-1}, 15g Cl ha^{-1} and Wediaker	N0C2V3	26	46kg N ha^{-1}, 10g Cl ha^{-1} and wediaker	N2C1V3
3	0kg N ha^{-1}, 15g Cl ha^{-1} and Deber	N0C2V2	27	46kg N ha^{-1}, 10g Cl ha^{-1} and Deber	N2C1V2
4	0kg N ha^{-1}, 0g Cl ha^{-1} and Wediaker	N0C0V3	28	46kg N ha^{-1}, 20g Cl ha^{-1} and Birhan	N2C3V1
5	0kg N ha^{-1}, 0g Cl ha^{-1} and Birhan	N0C0V1	29	46kg N ha^{-1}, 20g Cl ha^{-1} and wediaker	N2C3V3
6	0kg N ha^{-1}, 0g Cl ha^{-1} and Deber	N0C0V2	30	46kg N ha^{-1}, 20g Cl ha^{-1} and Deber	N2C3V2
7	0kg N ha^{-1}, 10g Cl ha^{-1} and Deber	N0C1V2	31	46kg N ha^{-1}, 0g Cl ha^{-1} and wediaker	N2C0V3
8	0kg N ha^{-1}, 10g Cl ha^{-1} and wediaker	N0C1V3	32	46kg N ha^{-1}, 0g Cl ha^{-1} and Birhan	N2C0V1
9	0kg N ha^{-1}, 10g Cl ha^{-1} and Birhan	N0C1V1	33	46kg N ha^{-1}, 0g Cl ha^{-1} and Deber	N2C0V2
10	0kg N ha^{-1}, 20g Cl ha^{-1} and Deber	N0C3V2	34	46kg N ha^{-1}, 15g Cl ha^{-1} and Birhan	N2C2V1
11	0kg N ha^{-1}, 20g Cl ha^{-1} and wediaker	N0C3V3	35	46kg N ha^{-1}, 15g Cl ha^{-1} and Deber	N2C2V2
12	0kg N ha^{-1}, 20g Cl ha^{-1} and Birhan	N0C3V1	36	46kg N ha^{-1}, 15g Cl ha^{-1} and wediaker	N2C2V3
13	23kg N ha^{-1}, 20g Cl ha^{-1} and Birhan	N1C3V1	37	69kg N ha^{-1}, 0g Cl ha^{-1} and Birhan	N3C0V1
14	23kg N ha^{-1}, 20g Cl ha^{-1} and wediaker	N1C3V3	38	69kg N ha^{-1}, 0g Cl ha^{-1} and Deber	N3C0V2
15	23kg N ha^{-1}, 20g Cl ha^{-1} and Deber	N1C3V2	39	69kg N ha^{-1}, 0g Cl ha^{-1} and wediaker	N3C0V3
16	23kg N ha^{-1}, 0g Cl ha^{-1} and Birhan	N1C0V1	40	69kg N ha^{-1}, 15g Cl ha^{-1} and Deber	N3C2V2
17	23kg N ha^{-1}, 0g Cl ha^{-1} and wediaker	N1C0V3	41	69kg N ha^{-1}, 15g Cl ha^{-1} and Birhan	N3C2V1
18	23kg N ha^{-1}, 0g Cl ha^{-1} and Deber	N1C0V2	42	69kg N ha^{-1}, 15g Cl ha^{-1} and wediaker	N3C2V3
19	23kg N ha^{-1}, 10g Cl ha^{-1} and wediaker	N1C1v3	43	69kg N ha^{-1}, 10g Cl ha^{-1} and Birhan	N3C1V1
20	23kg N ha^{-1}, 10g Cl ha^{-1} and Birhan	N1C1V1	44	69kg N ha^{-1}, 10g Cl ha^{-1} and wediaker	N3C1V3
21	23kg N ha^{-1}, 10g Cl ha^{-1} and Deber	N1C1V2	45	69kg N ha^{-1}, 10g Cl ha^{-1} and Deber	N3C1V2
22	23kg N ha^{-1}, 15g Cl ha^{-1} and Birhan	N1C2V1	46	69kg N ha^{-1}, 20g Cl ha^{-1} and Deber	N3C3V2
23	23kg N ha^{-1}, 15g Cl ha^{-1} and wediaker	N1C2V3	47	69kg N ha^{-1}, 20g Cl ha^{-1} and wediaker	N3C3V3

24	23kg N ha^{-1}, 15g Cl ha^{-1} and Deber	N1C2V2	48	69kg N ha^{-1}, 20g Cl ha^{-1} and Birhan	N3C3V1

The plots were laid out and leveled manually. One and 1.5 m distances were maintained between each plot and each block respectively. The N fertilizer rates (in the form of urea) were applied to corresponding experimental plot divided in to two halves. One-half of the fertilizers (i.e., as per the treatment) were applied uniformly within the rows during planting time while the remaining half of each N fertilizer treatments were top dressed on the inter row spaces two weeks after emergence of the crop. The herbicide was dilutes by the recommended water (200 liter ha^{-1}) and sprayed three weeks after emergence of the crop to the soil. Due to the need to monitor striga emergence without obstruction and quantify the effect nitrogen fertilizer, herbicide and variety on *Striga* only, plots were kept free of other weeds by repeated hoe and hand weeding at all growth stages.

2.3 Measurements and Measurement Methods on striga

Days to first striga emergence: was the day from the sowing date of the crop up to first above ground appearance of striga.

Days to first flowering: strict observation was made to take the data on this parameter starting day after emergence of striga up to the last sorghum maturity in each plot.

Number of striga count: number of striga counted in one meters square of each plot by quadrate method at 45DAP, 65DAP, and 85DAP to compare infestation level.

Branch number per Striga plant; branches were counted per plant from three randomly selected plants per plot and was averaged as number of branch per plant.

Striga count per sorghum plant; striga plants emerged around the selected samples of sorghum (five sorghum plants) was counted at 50% of crop flowering.

Striga height: height of the striga plant was recorded from the ground up to the shoot apex from the selected five plants of striga and data were taken average one.

Biomass (kg/m2): biomass of striga was measured from the whole plot (harvested plot) the change to the meter square at the end of counting (85DAP)

2.3. Data Analysis

All collected data were statistically subjected to analysis of variance (ANOVA) for the split spit plot design of the experiment using .JMP-18th statistical package on a computer. Whenever treatment effects were significant (P < 0.05), mean comparison between and/or among treatment means were computed using Dunken's Multiple Range test at p<0.05.

3 Result and discussion

3.1 Days to striga emergence, flowering and stand count

Nitrogen levels, herbicide rates and varieties interaction showed highly significant difference (p < 0.01) for striga emergence, flowering and striga count per sorghum plant (Table: 3). Striga emergence was early by 20.67days in both the controls (no nitrogen fertilizer and no herbicide) with V2 and V3 (N0C0V2 and N0C0V3) as compared to application of 69 kg N ha^{-1}, 20g Cl ha^{-1} with V1 and 46 kg N ha^{-1}, 20g Cl ha^{-1} with V2. The reason for late emergence of striga may be N fertilizer and herbicide with resistance and moderate resistance varieties delays the emergence of striga by minimizing the early attachment of striga to sorghum roots and subsequently reducing the number of striga shoots that emerge above ground. Application of 69 kg N ha^{-1}, 20g Cl ha^{-1} and V1 delayed flowering of striga more significantly than controls with V3 (N0C0V3). This could be due to the delayed on emergence and the computation among the sorghum and striga for resources may be low in the plots that received or treated by N fertilizer, herbicide and resistance variety than untreated plots with susceptible variety.

The highest number of striga per sorghum (17.26 plants) was recorded from plots with no N, herbicide and variety V3 (N0C0V3) whereas the lowest number (0.4 plants) of striga was counted from plots with 69 kg N ha^{-1}, 20g Cl ha^{-1} and V1 (N3C3V1). Generally striga count per sorghum decrease with increasing N fertilizer, herbicide within varieties. By using integrated management of striga it reduced striga number per sorghum by 97.82%.

3.2 Effect of N fertilizer, herbicide application, and varieties on Striga count at different time

At 45DAP maximum striga counted was from both controls (N0C0) with V3 (15.59 plants m-2) whereas minimum striga was counted from 69kg N ha^{-1},15g Cl ha^{-1} with V1 (0.37plants m^{-2}). Striga counted at 65DAP and at 85DAP was increases the number of striga a little bit with resistance and susceptible varieties. This shows that striga emergence later due to the effect of N fertilizer, herbicide

and varieties. The highest striga m^{-2} was counted from both at 65DAP and 85DAP in plots of the control with V3 (142.93 plants m^{-2} and 222.04 plants m^{-2}) respectively the difference only the time taken to counted the striga. The lowest striga were counted from application of 46 and 69 kg N ha^{-1} and all herbicide rates except the control with V1 (1.11 plants m^{-2}) at 65DAP, but at 85DAP lowest striga were counted from application of all N levels except the control of N fertilizer and herbicide rates with V1 (2.22 plants m^{-2}). Integrated use of Nitrogen fertilizer, herbicide and variety decreases the number of striga count at 45, 65 and 85DAP by 97.62%, 99.22% and 98.75% respectively. This result is in line with [7] the authors reported that at 60DAS highest sriga was counted from control (untreated plot) as compare to other treated plots (3plants/m2). Generally strica emergence and striga count was reduces so it is known to increase the yield of sorghum because the host almost very low in number in the treated ones compare with both controls with all varietes.

Table 3: Interaction effect of nitrogen levels, herbicide rates, and varieties on striga parameters

Treatments	DE	DF	SC-Pl	45DAPm-2	65DAPm-2	85DAPm-2
N0C0V1	56.3^{a-e}	75.33^{c-k}	2.06(1.6)$^{k-n}$	4.03(2.12)^{f}	5.15(2.26)$^{m-q}$	11.15(3.33)$^{o-u}$
N0C0V2	40.67^{j}	70^{h-k}	7.93(2.9)^{de}	8.11(2.93)^{c}	109.48(10.46)^{b}	134.67(11.6)^{c}
N0C0V3	40.67^{j}	66^{k}	17.26(4.21)^{a}	15.59(4.01)^{a}	142.93(11.95)^{a}	222.04(14.9)^{a}
N0C1V1	55.3^{a-f}	77^{b-g}	1.2(1.3)$^{n-q}$	0,74(1.1)$^{m-q}$	1.33(1.15)^{pq}	5.74(2.37)$^{t-v}$
N0C1V2	42.7^{g-j}	76^{c-i}	3.46(1.99)$^{h-j}$	1.44(1.39)$^{h-k}$	8.19(2.86)^{lm}	17.81(4.21)$^{m-o}$
N0C1V3	46.7^{d-j}	72.33^{f-k}	5.73(2.49)^{g}	3(1.87)^{g}	24.26(4.92)^{hi}	79.15(8.89)^{g}
N0C2V1	58^{a-d}	76.33^{b-g}	2.06(1.6)$^{k-n}$	0.51(1)^{pq}	1.59(1.25)^{pq}	5.63(2.37)$^{t-v}$
N0C2V2	46.3^{d-j}	76^{c-i}	2.73(1.79)$^{j-l}$	1.37(1.36)$^{i-l}$	8.67(2.94)^{lm}	14.89(3.83)$^{m-p}$
N0C2V3	51.67^{a-j}	75.33^{c-k}	7.4(2.8)^{e}	1.25(1.32)$^{i-n}$	10.37(3.21)^{kl}	36.19(6.01)^{i}
N0C3V1	53^{a-h}	74^{d-k}	1.46(1.4)$^{n-p}$	0.55(1.02)$^{o-q}$	1.48(1.21)^{pq}	5.7(2.92)$^{t-v}$

	DE	DF	Sc_pl	45DAP	65DAP	85DAP
N0C3V2	48[c-j]	75.33[c-k]	1.66(1.47)[n-p]	0.77(1.2)[l-q]	2(1.41)[pq]	5.56(2.59)[t-v]
N0C3V3	44.33[f-j]	73[e-k]	3(1.87)[j]	1.5(1.41)[h-k]	7.07(2.65)[l-n]	13.96(3.73)[n-q]
N1C0V1	54[a-g]	77[b-g]	3.33(1.95)[j]	1.14(1.28)[j-o]	6.07(2.45)[l-p]	25.26(5.02)[kl]
N1C0V2	43.3[g-j]	72[g-k]	6.6(2.66)[f]	2.81(1.81)[g]	27.07(5.2)[h]	51.41(7.16)[h]
N1C0V3	44[f-j]	73[e-k]	6.4(2.62)[fg]	4.63(2.26)[e]	56.04(7.47)[e]	114.85(10.71)[e]
N1C1V1	51.3[a-j]	77[b-g]	1.2(1.3)[n-q]	0.55(1.02)[o-q]	1.44(1.2)[pq]	2.89(1.69)[v]
N1C1V2	47.3[c-j]	75.33[c-k]	1.8(1.51)[m-o]	0.59(1.04)[o-q]	5.11(2.25)[m-q]	6.93(2.37)[r-v]
N1C1V3	46[e-j]	77[b-g]	5.66(2.48[g]	1.74(1.49)[hi]	22.19(4.7)[i]	46.37(5.02)[h]
N1C2V1	58.7[a-c]	78.33[a-d]	1.6(1.44)[n-p]	0.74(1.1)[m-q]	1.56(1.24)[pq]	5.67(2.29)[t-v]
N1C2V2	50[b-j]	77[b-g]	2.06(1.6)[l-n]	0.55(1.02)[o-q]	2.85(1.68)[n-q]	7.07(2.63)[r-v]
N1C2V3	49.7[b-j]	74.67[c-k]	4.26(2.17)[h]	1.11(1.26)[j-p]	7.78(2.78)[lm]	18(2.65)[mn]
N1C3V1	60.33[ab]	79.33[a-c]	0.8(1.13)[pq]	0.59(1.04)[o-q]	1.41(1.17)[pq]	2.93(1.69)[v]
N1C3V2	52[a-j]	76[c-h]	1.33(1.35)[n-p]	0.74(1.1)[m-q]	1.89(1.37)[pq]	5.7(1.64)[uv]
N1C3V3	48.7[b-j]	74.67[c-k]	1.5(1.39)[n-p]	0.92(1.19)[k-q]	1.81(1.34)[pq]	5.26(2.29)[uv]
CV (%)	11.6	3.3	12.8	13.9	13.6	11
LSD(0.05)	9.456	4.114	0.77	0.492	3.932	5.886
F Pr	<.001	<.001	<.001	<.001	<.001	<.001

DE = days to first striga emergence, DF = days to flowering, Sc_pl = striga count per sorghum plant, 45DAP = striga counts 45 days after sorghum planting, 65DAP = striga count 65 days after sorghum planting, 85DAP = striga counts 85 days after sorghum planting, , N (0, 1, 2 and 3) = Nitrogen levels, C (0, 1, 2 and 3) = herbicide rates, V1 = Brihan, V2 = Deber and V3 = wedia

Continued table

Treatments	DE	DF	SC-Pl	45DAPm-2	65DAPm-2	85DAPm-2
N2C0V1	52.3[a-j]	76[c-h]	2.7(1.77)[j-m]	1.11(1.26)[j-p]	2.85(1.68)[n-q]	13.26(3.63)[n-s]
N2C0V2	41[ij]	72.33[f-k]	9.7(3.18)[c]	6.22(2.59)[d]	77.33(8.79)[d]	122.9(11.06)[d]
N2C0V3	41.3[h-j]	72.33[f-k]	11.3(3.42)[b]	9.66(3.18)[b]	104.78(10.23)[c]	142.6(11.94)[b]
N2C1V1	58[a-d]	76.67[b-g]	1.33(1.35)[n-p]	0.74(1.1)[m-q]	1.74(1.31)[pq]	3.04(1.74)[v]
N2C1V2	52[a-j]	76[c-h]	1.4(1.37)[n-p]	1.33(1.35)[i-m]	5.37(2.31)[m-q]	13.74(3.7)[n-r]
N2C1V3	44[f-j]	73[e-k]	8.66(3.02)[d]	2.81(1.82)[g]	51.41(7.15)[f]	101.07(10.05)[f]
N2C2V1	52.7[a-i]	78[a-e]	0.8(1.13)[pq]	0.77(1.12)[l-q]	1.11(1.05)[q]	2.41(1.55)[v]
N2C2V2	48[c-j]	76.33[c-h]	2.73(1.79)[j-l]	1.33(1.35)[i-m]	2.67(1.63)[n-q]	7.41(2.71)[q-v]
N2C2V3	49[b-j]	75.67[c-k]	4.2(2.16)[hi]	0.7(1.09)[n-q]	13.93(3.73)[jk]	28.33(5.31)[jk]
N2C3V1	50[b-j]	78[a-e]	1(1.22)[o-q]	0.74(1.1)[m-q]	1.33(1.15)[pq]	2.63(1.61)[v]
N2C3V2	62.33[a]	74.33[c-k]	1.86(1.53)[l-o]	1.11(1.26)[j-p]	2.85(1.68)[n-q]	12.44(3.52)[n-t]
N2C3V3	52.3[a-j]	77[b-g]	1.4(1.37)[n-p]	1.59(1.44)[h-j]	2.93(1.71)[n-q]	6.19(2.48)[t-v]
N3C0V1	57[a-e]	76.67[b-g]	1.73(1.49)[n-p]	1.11(1.26)[j-p]	2.89(1.69)[n-q]	5.26(2.29)[uv]
N3C0V2	44[f-j]	75[c-k]	10.2(3.26)[c]	6.4(2.62)[d]	41.48(6.43)[g]	74.04(8.6)[g]
N3C0V3	42.3[g-j]	71[h-k]	6.4(2.62)[fg]	3.(1.9)[g]	38.74(6.21)[g]	99.63(9.97)[f]
N3C1V1	57.7[a-e]	78.33[a-d]	1(1.22)[o-q]	0.59(1.04)[o-q]	1.11(1.05)[q]	2.22(1.48)[v]
N3C1V2	47.3[c-j]	77.67[a-e]	6.4(2.62)[fg]	2(1.57)[h]	15.78(3.94)[j]	32.33(5.67)[ij]
N3C1V3	57.7[a-e]	76.33[c-h]	2(2.62)[l-n]	1.14(1.28)[j-o]	2.67(1.63)[n-q]	8.74(2.95)[p-v]
N3C2V1	57.7[a-e]	78.33[a-d]	1(1.22)[o-q]	0.37(0.93)[o-q]	1.11(1.05)[q]	2.22(1.48)[v]
N3C2V2	50.7[a-j]	78.67[a-d]	3.4(1.97)[ij]	1.22(1.31)[i-n]	6.89(2.62)[l-n]	21.22(4.6)[lm]
N3C2V3	49[b-j]	76[b-g]	2(1.57)[l-n]	1.66(1.47)[h-j]	8.89(2.98)[lm]	18.56(4.3)[mn]
N3C3V1	62[a]	82.33[a]	0.4(0.94)[q]	1.11(1.26)[j-p]	1.11(1.05)[q]	3.78(.9)[v]
N3C3V2	51.3[a-j]	78.67[a-d]	2.93(1.85)[jk]	1.4(1.37)[i-k]	6.78(2.6)[l-o]	18.56(4.29)[mn]

	DE	DF	Sc_pl	45DAP	65DAP	85DAP
N3C3V3	$52.7^{a\text{-}i}$	$77^{b\text{-}g}$	$1.86(1.53)^{l\text{-}o}$	$1.11(1.26)^{j\text{-}p}$	$2.52(1.58)^{n\text{-}q}$	$6.48(2.54)^{t\text{-}v}$
CV (%)	11.6	3.3	12.8	13.9	13.6	11
LSD(0.05)	9.456	4.114	0.77	0.492	3.932	5.886
F Pr	<.001	<.001	<.001	<.001	<.001	<.001

DE = days to first striga emergence, DF = days to flowering, Sc_pl = striga count per sorghum plant, 45DAP = striga counts 45 days after sorghum planting, 65DAP = striga count 65 days after sorghum planting, 85DAP = striga counts 85 days after sorghum planting, , N (0, 1, 2 and 3) = Nitrogen levels, C (0, 1, 2 and 3) = herbicide rates, V1 = Brihan, V2 = Deber and V3 = wediaker

3.2. Effect of N fertilizer, herbicide application, and varieties on striga branch number of striga and striga plant height

Nitrogen levels*herbicide rates and varieties interaction showed highly significant difference ($p < 0.01$) for branch number per striga and striga plant height (Table: 4). Higher branch number of striga was observed from plots that application of 0kg N ha^{-1}, 20g Cl ha^{-1} with V3 (4.55 branches per striga), however lower striga branch was observed from application of 69 kg N ha^{-1} 20g Cl ha^{-1} with V1 (0.77 branches per striga). The expectation was that branch number of striga highest in plots of both controls with variety V3 but the result was from other treatment this may be due to the striga number of computation for resources to develop and branching.

Highest striga plant height was detected in V2 and V3 (62.67 and 58.87 cm respectively) with 0kg N ha^{-1} and 0g Cl ha^{-1} (both controls) whereas lowest striga plant height was detected from V1 (3.68 cm) with application 0 kg N ha^{-1}(control), 10 g Cl ha^{-1} with V1. The probability reason for this result in the control plots the number of striga was highest than sorghum plants due to that shading cannot affect for striga and free to growth when compared with treated plots with resistance variety.

Table 4: effect of nitrogen, herbicide, and varieties on striga branch number and striga plant height

Treatments	Br_no/plant	Ph	Treatments	Br_no/plant	Ph
N0C0V1	$2.55(1.74)^{g-i}$	$32.0(5.66)^{f-j}$	N1C0V1	$2.33(1.68)^{g-j}$	$35.8(5.97)^{ef}$
N0C0V2	$2.88(1.84)^{d-h}$	$62.67(7.91)^{a}$	N1C0V2	$2.88(1.82)^{d-h}$	$41.87(6.46)^{d}$
N0C0V3	$3.66(2.04)^{bc}$	$58.87(7.67)^{a}$	N1C0V3	$3.88(2.09)^{b}$	$47.2(6.86)^{c}$
N0C1V1	$2.77(1.81)^{e-h}$	$17.4(4.16)^{pq}$	N1C1V1	$3.55(2.01)^{b-d}$	$17.3(4.15)^{pq}$
N0C1V2	$2.33(1.68)^{g-j}$	$37.13(6.09)^{e}$	N1C1V2	$2.22(1.64)^{h-k}$	$23.8(4.87)^{l-n}$
N0C1V3	$3.88(2.08)^{b}$	$46.6(6.81)^{c}$	N1C1V3	$3(1.86)^{c-g}$	$50.13(7.07)^{bc}$
N0C2V1	$2.44(1.71)^{g-i}$	$3.68(3.68)^{qr}$	N1C2V1	$1.22(1.31)^{m-o}$	$10.6(3.25)^{r-t}$
N0C2V2	$2.66(1.77)^{f-i}$	$33.9(5.81)^{e-g}$	N1C2V2	$1.33(1.35)^{l-o}$	$27.1(5.19)^{kl}$
N0C2V3	$4.55(2.24)^{a}$	$34.7(5.88)^{e-g}$	N1C2V3	$3.77(2.06)^{b}$	$32.2(5.67)^{f-i}$
N0C3V1	$3.44(1.98)^{b-e}$	$19.1(4.37)^{op}$	N1C3V1	$1(1.22)^{m-o}$	$9(2.99)^{r-t}$
N0C3V2	$1.11(1.26)^{m-o}$	$20.8(4.5)^{n-p}$	N1C3V2	$1.33(1.35)^{l-o}$	$12(3.46)^{rs}$
N0C3V3	$2.77(1.81)^{e-h}$	$26.9(5.18)^{kl}$	N1C3V3	$1.44(1.39)^{l-o}$	$24.7(4.96)^{l-n}$
CV (%)	15.8	8.4	CV (%)	15.8	8.4
LSD(0.05)	0.633	4.01	LSD(0.05)	0.633	4.01
F Pr	<.001	<.001	F Pr	<.001	<.001

Continue

Treatments	Br_no/plant	Ph	Treatments	Br_no/plant	Ph
N2C0V1	$2.55(1.74)^{g-i}$	$32.6(5.7)^{e-h}$	N3C0V1	$1.33(1.35)^{l-o}$	$13.47(3.66)^{qr}$
N2C0V2	$3.33(1.95)^{b-f}$	$50.7(7.12)^{bc}$	N3C0V2	$2.77(1.8)^{e-h}$	$50.4(7.09)^{bc}$
N2C0V3	$2.55(1.74)^{g-i}$	$52.07(7.21)^{b}$	N3C0V3	$3.55(2.01)^{b-d}$	$54.47(7.38)^{b}$
N2C1V1	$1.55(1.43)^{k-n}$	$18.93(4.34)^{op}$	N3C1V1	$1.33(1.35)^{l-o}$	$6.6(2.56)^{t}$
N2C1V2	$2.44(1.71)^{g-i}$	$17.4(4.17)^{pq}$	N3C1V2	$2.66(1.77)^{f-i}$	$46.33(6.8)^{c}$
N2C1V3	$2(1.57)^{i-l}$	$52.8(7.26)^{b}$	N3C1V3	$3.77(2.06)^{b}$	$25.27(5.02)^{lm}$
N2C2V1	$1.55(1.42)^{k-n}$	$10.73(3.27)^{r-t}$	N3C2V1	$1.33(1.35)^{l-o}$	$6.6(2.56)^{t}$
N2C2V2	$3.77(2.06)^{b}$	$28.33(5.31)^{h-l}$	N3C2V2	$3.33(1.95)^{b-f}$	$28(5.28)^{i-l}$

	Br no/plant	Ph		Br no/plant	Ph
N2C2V3	$2.44(1.71)^{g-i}$	$30.9(5.55)^{g-k}$	N3C2V3	$0.88(1.17)^{no}$	$34.6(5.88)^{e-g}$
N2C3V1	$1.33(1.35)^{l-o}$	$9.67(3.1)^{r-t}$	N3C3V1	$0.77(1.12)^{o}$	$7.93(2.81)^{st}$
N2C3V2	$1.66(1.46)^{j-m}$	$19(4.35)^{op}$	N3C3V2	$3.33(1.95)^{b-f}$	$27.93(5.28)^{i-l}$
N2C3V3	$3(1.86)^{c-g}$	$22.5(4.73)^{m-o}$	N3C3V3	$2(1.57)^{i-l}$	$27.53(5.24)^{j-l}$
CV (%)	15.8	8.4	CV (%)	15.8	8.4
LSD(0.05)	0.633	4.01	LSD(0.05)	0.633	4.01
F Pr	<.001	<.001	F Pr	<.001	<.001

Br no/plant = branch number per striga plant, Ph = striga plant height N (0, 1, 2 and 3)
Nitrogen levels, C (0, 1, 2 and 3) = herbicide rates, V1 = Brihan, V2 = Deber, V3 = wediaker and PH = striga plant heigh

3.2. Effect of N fertilizer, herbicide application, and varieties on Striga biomass

Nitrogen levels*herbicide rates and varieties interaction showed highly significant difference ($p < 0.01$) for biomass of striga (Table: 5)The greatest striga biomass were measured from application of 46 kg N ha^{-1} with control of herbicide and V3 (0.263kg m^{-2}) and statistically similar with the application of 69 kg N ha^{-1} with control herbicide with V2 whereas the lowest striga biomass were measured from plots that application of 69 kg N ha^{-1}, 20g Cl ha^{-1} herbicide with all varieties (0.001kg m^{-2}) and almost statistically similar with all rates of herbicide and N level including the control with V1 although the same herbicide rates and varieties. Biomass of striga was affected by herbicide rates than nitrogen levels and varieties. Generally integrated management of striga is the best method of control striga. Using integrated management of striga reduces the dray weight of striga by 99.61%. This result in line with study of [8] who stated that integrated striga management on intercropping system, fusarium-inoculum or both in combination significantly reduced striga dray biomass. It also agrees with [9] the authors reported that the combined use of the mycoherbicides and *Striga* resistant maize varieties reduced *Striga* dry weight by 81.4 %.

Table 5: Effect of nitrogen*herbicide* varieties on biomass of striga

Treatments	Biomass (m-2)	Treatments	Biomass (m-2)	Treatments	Biomass (m-2)	Treatments	Biomass (m-2)
N0C0V1	$0.0814(0.76)^{g-i}$	N1C0V1	$0.040(0.73)^{i-k}$	N2C0V1	$0.025(0.71)^{jk}$	N3C0V1	$0.122(0.71)^{d-g}$
N0C0V2	$0.133(0.84)^{c-f}$	N1C0V2	$0.066(0.79)^{h-j}$	N2C0V2	$0.147(0.8)^{c-e}$	N3C0V2	$0.251(0.78)^{a}$
N0C0V3	$0.207(0.9)^{b}$	N1C0V3	$0.201(0.83)^{b}$	N2C0V3	$0.263(0.87)^{a}$	N3C0V3	$0.082(0.9)^{g-i}$
N0C1V1	$0.002(0.7)^{k}$	N1C1V1	$0.0014(0.7)^{k}$	N2C1V1	$0.0029(0.7)^{k}$	N3C1V1	$0.0089(0.7)^{k}$
N0C1V2	$0.0259(0.73)^{jk}$	N1C1V2	$0.018(0.71)^{k}$	N2C1V2	$0.0089(0.72)^{k}$	N3C1V2	$0.0407(0.75)^{i-k}$
N0C1V3	$0.1388(0.77)^{c-f}$	N1C1V3	$0.155(0.8)^{cd}$	N2C1V3	$0.174(0.82)^{bc}$	N3C1V3	$0.0467(0.71)^{i-k}$
N0C2V1	$0.0033(0.7)^{k}$	N1C2V1	$0.004(0.71)^{k}$	N2C2V1	$0.0096(0.7)^{k}$	N3C2V1	$0.0011(0.7)^{k}$
N0C2V2	$0.044(0.76)^{i-k}$	N1C2V2	$0.018(0.72)^{jk}$	N2C2V2	$0.011(0.71)^{e-g}$	N3C2V2	$0.0089(0.73)^{k}$
N0C2V3	$0.1(0.78)^{f-h}$	N1C2V3	$0.04(0.71)^{i-k}$	N2C2V3	$0.0025(0.78)^{k}$	N3C2V3	$0.0429(0.73)^{i-k}$
N0C3V1	$0.0037(0.7)^{k}$	N1C3V1	$0.0018(0.71)^{k}$	N2C3V1	$0.0174(0.7)^{k}$	N3C3V1	$0.001(0.7)^{k}$
N0C3V2	$0.007(0.71)^{k}$	N1C3V2	$0.0033(0.7)^{jk}$	N2C3V2	$0.0025(0.72)^{k}$	N3C3V2	$0.033(0.73)^{jk}$
N0C3V3	$0.0059(0.7)^{k}$	N1C3V3	$0.002(0.71)^{k}$	N2C3V3	$0.0325(0.71)^{jk}$	N3C3V3	$0.0067(0.71)^{k}$
CV (%)	24.8	CV (%)	24.8	CV (%)	24.8	CV (%)	24.8
LSD(0.05)	0.0389	LSD(0.05)	0.0389	LSD(0.05)	0.0389	LSD(0.05)	0.0389
F Pr	<.001	F Pr	<.001	F Pr	<.001	F Pr	<.001

4. Conclusion

The result that shows application of nitrogen fertilizer, application of herbicide and varieties has influence on striga emergence, striga count at different time, striga plant height, and biomass of striga. Use of N fertilizer, application of chlorsulfrun and resistance variety, reduces the plant height of striga, branch number, and biomass of striga. Generally use of integrated management is the best and useful for striga control even for minimize seed production by delayed the flowering time and break out the season ad striga cannot set seed

5. References

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