EFFECT OF REDUCED TILLAGE, RESIDUE RETENTION AND CROPPING SYSTEM ON GROWTH AND YIELD OF GREEN GRAM IN ARID AND SEMI ARID ENVIRONMENTS OF KENYA
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ABSTRACT

Green gram yield has remained significantly low despite the development of improved varieties. This could be attributed to low soil fertility, unreliable rainfall as well as inappropriate cropping practices. Nonetheless, implementation of precision agriculture (PA) within the context of reduced tillage incorporated with residue retention and intercropping has the potential to increase green gram yield in arid and semi-arid environments. The objective of this study was to determine the effect of reduced tillage, residue retention and cropping system on green gram growth and yield. Results showed that green gram grown under tied ridges performed better than those under conventional tillage and no till. Residue retention of 3 t/ha significantly increased green gram yield. The result showed that tied ridges × residue retention 3 t/ha × sole crop interaction increased green gram yield. Farming practices incorporating tied ridges, residue retention and sole crop system can be applied as an aspect of PA to increase agricultural productivity and sustainability.

Keywords: tied ridges, interactions, sole crop, seed yield

INTRODUCTION

Green gram production is below the yield potential due to continuous exploitation of natural resources to meet the increased food demand to feed the steadily growing population. Precision agriculture is a considered as a solution for improved crop yield and sustainable green gram production. Green gram (*Vigna radiata*) is a significant leguminous crop which does well in arid and semi-arid environments and improving its productivity will could improve livelihood of people living in such hardship environments. Unfortunately, green gram yield has remained significantly low despite continuous development of improved varieties, this could be attributed to low soil fertility as well as inappropriate tillage and cropping practices among others. Hence, implementation of precision agriculture in green gram production coupled with reduced tillage, residue retention and cropping system could improve green gram yield (Friedrich et al., 2009).

There has been significant amount of research done to evaluate residue retention, reduced tillage as well as intercropping with emphasis on cereals but little emphasis on green gram crop (Kitonyo et al., 2018). Little is known on how mulch contribute to increased green gram growth and yield (Giller et al., 2009). This research attempted to fill the above identified gaps in the effect of reduced tillage, residue retention and cropping system on green gram growth and yield. Thus, the objective of this research was to evaluate the effect of reduced tillage, residue retention and cropping system on green gram growth and yield. It was hypothesized that reduce tillage, residue retention and intercropping positively influence growth and yield of green gram.

MATERIALS AND METHODS

Field experiments were concurrently conducted under rain fed conditions both on-station at Kenya Agricultural and Livestock Research Organization (KALRO) in Katumani and on-farm Kyua, Katangi both in Machakos County Kenya during 2020 short rains and 2021 long rains. The experiments were laid out in randomized complete block design with split-split plot arrangements. The treatments comprised of three tillage practices (conventional tillage, tied-ridges and no-till), two crop residue amount (0 and 3 t/ha) and two cropping systems (sole crop and intercrop). Main plot comprised tillage systems, residue amount sub plot and cropping system sub-sub plot. The test crop was green gram KS20 variety with sorghum Gadam variety as intercrop.

Green gram yield components collected were seed yield, number of pods per plant, number of seeds per pod and 1000 seed weight. The data was subjected to analysis of variance by use of GenStat Version. 12 statistical software. Treatment means were compared and separated using Fisher's least significant difference test at 5% probability level.

RESULTS AND DISCUSSION

Green gram seed yield was significantly ($P \leq 0.001$) affected by tillage practices, residue amount and cropping system. Green gram yield was significantly ($P \leq 0.004$) affected by interactions between tillage practices * residue amount, tillage practices * cropping system and residue amount * cropping system ($P \leq 0.003$). Interactions of tillage practices * residue amount * cropping residue had no significant effect on green gram yield. Green gram yield increased under tied ridges by 1.58 t/ha this could be due to higher moisture conservation because of tied ridges. Green gram yield under residue retention out yielded those under bare land by 1.4 t/ha. Increase in yield under residue retention could be attributed to prevention of soil moisture evaporation available for crop use. Sole green gram crops out-yielded intercrop by 1.305 t/ha. Increase in yield under sole crop could be attributed to lack of competition of resources from other crops (Masaku, M. K., 2019).

Reduction of yield under intercrop could be due to presence of interspecies competition. Green gram yield increased under interaction between tied ridges * residue retention by 1.58 t/ha which could be attributed to rainwater capture and retentions and soil moisture conservation due to mulch and tied ridges. Yield increased because of tied ridges * sole crop interaction by 1.728 t/ha due absence of competition and presence of soil moisture conservation.

Number of seeds per pod increased under tied ridges by (13.9), residue retention by (13.1) and sole crop by (13.2). Number of seeds per pod increased under interaction between tied ridges * sole crop by 12.3 and residue retention * sole crop by (13.6). Number of seeds per pod increased under interaction between tied ridges * residue retention * sole crop (14.9).

Number of pods per plant increased under tied ridges by (13.3), residue retention by (11.9) and sole crop by (11.1). Interaction between tied ridges * sole crop significantly affected number of pods per plant.

CONCLUSION AND RECOMMENDATION

The general findings suggest that tied ridges * residue retention * sole crop interaction was effective in increasing green gram growth and yield in comparison to conventional tillage, bare land and intercropping. Small scale farmers be encouraged to construct tied ridges for rainwater harvesting and utilization by crops. Crop residue retention in the farms need to be promoted for improved yield. More Research need to be done on the effect of tillage, residue

retention on various green gram varieties**.** More research needed on the critical residue amount for increased yield.

Table 1. Green gram yield under tillage, residue amount and cropping system during 2020 short rain and 2021 long rain seasons at Katangi.

Treatments	No. of pods/plant		No. of Seeds/pod		1000 Seed weight (g)		Seed yield t/ha	
	2020	2021	2020	2021	2020	2021	2020	2021
Tillage (T)								
CT	8.5	10.2	11.1	12.7	61.74	57.67	0.726	1.1327
No-till	7.9	6.1	11.1	12	59.13	57.28	0.388	0.7009
TR	10.2	13.3	12.4	13.9	64.51	66.32	0.599	1.3594
P Tillage	0.081	<.001	0.475	0.012	0.039	<.001	0.003	<.001
(P≤0.05)	2.106	0.366	3.0686	0.9378	3.696	1.711	0.10005	0.04761
Residue amount (Res)								
0 t/ha	8.1	8.5	10.8	12.6	60.29	58.52	0.9267	0.8709
3 t/ha	9.6	11.2	12.3	13.1	63.29	62.32	1.4033	1.2578
P Residue	0.139	<.001	0.001	0.019	0.014	0.001	<.001	<.001
(P≤0.05)	2.193	0.892	0.6219	0.3557	2.129	1.665	0.05961	0.01071
Cropping system (CS)								
Sole	9.1	10.5	11.4	13.2	62.5	61.76	1.305	1.305
Intercrop	8.6	9.2	11.7	12.5	61.09	59.08	1.025	1.025
P Cropping	0.664	0.004	0.092	0.001	0.252	<.001	<.001	<.001
(P≤0.05)	2.396	0.759	0.3926	0.3228	2.553	0.7	0.03126	0.02835
Significant levels								
Till * Res	0.7	0.033	0.255	0.178	0.985	0.178	0.004	0.205
Till * CS	0.382	0.0696	<.001	0.747	0.032	0.051	0.004	<.001
Res * CS	0.666	0.652	0.527	0.017	0.78	0.376	0.371	0.003
T * Res * CS	0.148	0.032	<.001	0.014	0.525	0.139	0.293	0.588

Table 2. Green gram yield under tillage, residue amount and cropping system during 2020 short rain and 2021 long rain seasons at Katumani.

Treatments	No. of pods/plant		No. of Seeds/pod		1000 Seed weight (g)		Seed yield t/ha	
	2020	2021	2020	2021	2020	2021	2020	2021
Tillage (T)								
CT	12.4	5.6	12.3	11.5	65.7	65.46	0.726	0.2058
No-till	8.6	5	11.9	11.4	62.3	59.8	0.388	0.145
TR	11.8	6.8	11.7	12	82.9	66.96	0.599	0.4035
P value	0.014	0.262	0.932	0.559	0.36	0.172	0.014	0.047
LSD (P≤0.05)	2.076	2.528	4.258	1.598	37.56	8.829	0.1127	0.19697
Residue amount (Res)								
0 t/ha	11.9	11.8	11.7	11.8	65	62.87	0.2228	0.2228
3 t/ha	9.9	11.5	12.3	11.5	75.7	65.27	0.2801	0.2801
P Residue	0.044	0.497	0.367	0.497	0.346	0.27	0.017	0.017
LSD (P≤0.05)	1.904	1.034	1.443	1.034	25.62	4.825	0.1146	0.04266
Cropping system (CS)								
Sole	11.1	6	11.7	11.9	75.4	64.8	0.2681	0.2681
Intercrop	10.8	5.6	12.2	11.4	65.2	63.35	0.2347	0.2347
P Cropping	0.694	0.561	0.404	0.141	0.358	0.053	0.076	0.076
LSD (P≤0.05)	1.831	1.538	1.23	0.76	23.23	1.469	0.1092	0.03762
Significant levels								
Till * Res	0.393	0.7	0.597	0.617	0.433	0.62	0.251	0.251
Till * CS	0.066	0.382	0.197	0.551	0.325	0.101	0.603	0.603
Res * CS	0.119	0.666	0.063	0.148	0.363	0.324	0.132	0.132
Till * Res * CS	0.293	0.237	0.12	0.546	0.416	0.039	0.393	0.393

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