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Abstract: Lablab crop is an essential pulse, cum vegetable, and is more adapted to different environmental conditions than any other legume. Like other crops, it is infested by insect pests. The specific objective was to assess the effect of field margin plants with pesticide properties on growth and yield of lablab. Lablab seeds, tephrosia vogelii powders and field margin plants (Ocimum, Hyptis and Sphaeranthus) were used in this study. The experimental field was tilled, then the plots of 10m x 10m were established at the distance of 20m apart and randomized complete block design (CRBD) with three replications was used to assign treatment in each plot. The growth components plant heights (H) and the number of leaves per plant were measured on the 4th, 8th and 12th weeks after germination while the yields was measured after harvest and threshing. The study findings demonstrated effectiveness of field margin plants with pesticide properties at the edge in reducing pest incidents by attracting more natural enemies on 4th week found 3 spiders and no insect pest compared to other treatments, and reduce severity of foliage damage as well as increasing lablab yields (129.84kg/ha) compared to those with no field margin pesticidal plants which yielded 115.49kg/ha, hence higher yields on plots with field margin pesticidal plants in combination with application of fish bean [Tephrosia vogelii] which yielded 222.70kg/ha. Hence, the use of field margins with desired pesticide properties offer a sustainable way to increase yield.

Key words: Field Margin plant, Pesticide, Botanical pesticide, natural enemy

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1. Introduction

Lablab [*Lablab purpureus*] is an ancient crop; its record dates back to Archuo botanical in India before 1500 BC [1]. In Africa, it is a traditional food and is counted as a lost crop [2](Maass et al., 2010). It is an annual crop which grows up to 40 inches high [3]. It is a versatile, variable and adaptable crop resource [2]. It is also an essential pulse, cum vegetable [3](Chandra & Kushwaha, 2013). Lablab can adapt to different environmental conditions more than any other legume [4]. It tolerates drought [5] thus offers comparable opportunities for African agriculture [2]; at the same time it improves soil fertility [6]. Lablab has numerous benefits as a pulse, vegetable, livestock feed, green manure, ornament, medicinal herb [7], and an important crop among smallholder farmers [4]. Its green pods give good amount of protein; and the leaves provide hay, silage, and green manure [8]. As other crops, lablab is infested by insect pests; hemipteran insects are serious plant pests which affect this crop [9]. The pests reduce the production of lablab in Tanzania; hence farmers do not get enough lablab harvests for food and surplus for sell [10]. The study examined the recovery of natural enemies in lablab crop due to the botanical pesticide (Tephrosia vogelii powder) and field margin plants around the lablab field.

Insect pests are a limiting factor infecting lablab crop from the field to storage [11]. The pests affect roots, stem, leaves, pods and seeds of lablab plant [12]. The major hindrance in production of lablab in Tanzania is pest [10]. The complication of pests in lablab is caused by geographical and weather conditions on the farm forcing farmers to apply synthetic pesticides in pest management, but few of them use botanical pesticides as a way to control pests [13]. Botanical pesticides have been promoted in this era due to their being environmentally friendly in the fields where they are applied [14]. Application of botanical pesticides has low impact on the environment as they do not have residual effects on the soil [15]. Pesticidal plants can repel insect pests when intercropped with plants or in mixed-cropping while attracting natural enemies [16]. The population of natural enemies available in the area depends on environmental conditions and source of food available [17].

2. Materials and methods

The study was conducted at NM-AIST field in Arusha, Northern Tanzania. The area is located within latitude $3^0$13’59.59’’S and longitude $37^0$14’54’’E at an altitude of 1268 m above sea level. The area receives a mean annual rainfall of about 1200 mm per annum, and has a mean temperature of about 18^0C. The common crops grown in this area are maize, common bean and vegetables.

Lablab seeds used for this experiment were obtained from ARI-Selian. *Tephrosia vogelii* in powder form was utilized to extract botanical pesticide while field margins plants (*Ocimum spp*, *Hyptis spp* and *Sphaeranthus spp*) which were used to attract the natural enemies were collected from nearby sources in Arusha and Kilimanjaro regions.

The growing period for the study was from 29th May 2019 to 24th October 2019. This was not the normal cropping season because normally the growing season starts in March. There was not enough rainfall in March; the researcher had to wait until the soil moisture was conducive for planting. The rainfall was not enough; after sowing the seeds the rain stopped, thus the crop germinated and continued to grow by utilizing the moisture which was obtained from rain fall before sowing.

The experimental field was tilled, and then twenty-four plots of each of 10 m x 10 m at the distance of 20 m apart were established. Randomized complete block design (CRBD) with four replications was used to assign treatments in each plot; there were six treatments. There was a challenge of water logging in part of the farm; hence one replication was discarded. Lablab seeds were sown in each randomly established plot in spaces of 75 cm between rows and 60 cm between holes. Three seeds of lablab were sown per hole, and after germination thinning was done to retain only two seedlings in order to have adequate space hence receive all proper growth requirements (moisture, nutrients, light) without having to compete with each other. In addition, four insecticidal plants (*Ocimum gratissimum*, *Hyptis suaveolens*, *Sphaeranthus suaveolens* and *Sesamum indicum*) were planted at 50 cm wide from the lablab field in a space of 20 cm to function as field margin plants. Unfortunately, the *Sesamum indicum* seeds didn't grow well due to the challenge of rain which stopped before planting. For crop performance, the experiment was managed by considering common agronomic practices including weeding.

A botanical pesticide was extracted from *Tephrosia vogelii* whereby the leaves were harvested and dried under the shade to avoid direct sunlight before being pound into powder. The powder was stored in dark conditions in containers. Before application, a solution was prepared by mixing 1 kg of the powder with 10 litres of water and 0.1% soap. The solution was used to enhance the extraction of active compounds from the *Tephrosia vogelii* leaves powder. The solution stayed for 24 hours, and then its juice was filtered through a cloth and used directly in a sprayer. The growth components plant heights (H) and the number of leaves per plant were measured on the 4th, 8th and 12th weeks after germination.

3. Statistical analysis

Data collected were subjected to Genstat statistical package version 22.1 to test for treatment effects over the study period. The differences between treatment means (abundance, insect pest damage, yield and yield parameters, were tested. One-way analysis of variance (ANOVA) was used to analyze the collected data and Fisher's Least Significant Difference (LSD) test was used to compare significant treatment means at a 5 % confidence interval ($P = 0.05$)

4. Results and discussion

Effect of field margin pesticidal plants versus no margin 4th one day before application of pesticide

Results showed that there was a significant (P~ 0.001) difference in the abundance of natural enemies across the treatments. Plot with field margin pesticide plants plot was seen to attract a higher number of natural enemies Spiders (3) compared to other treatments (Table).

Effect of field margin pesticidal plants versus no margin week 4 one day after application of pesticide

Table 2 shows that there was a significant (P~ 0.001) difference in abundance of natural enemies which was found in field margin pesticidal plants. The treatment that was visited by a high number of natural enemies was plot with field margin pesticidal plants. Parasitoid wasp (1.333) was abundance as shown in Table 2.

Effect of field margin pesticidal plants versus no margin week 8

The results show that treatments had significant influence on natural enemies. More natural enemies were found in the treatments which were surrounded by field margin plants with pesticidal properties compared to those which didn't have filed margin plants. The treatment which attracted more natural enemies was surrounded by field margin plants where the wasps (2) and spiders were observed in more abundance than other insects as shown in table 3.

Effect of field margin pesticidal plants versus no margin week 12

The results showed that there was a significant (P~0.001) difference in the abundance of natural enemies across treatments. Large number of natural enemies were observed in the plots surrounded with pesticidal plants (2) spiders (2), while insect pests were observed in larger number from plots without field margins.

Lablab growth as affected by field margin pesticidal plants

The growth components plant heights (H) and the number of leaves per plant were measured at the end of the 4^{th}, 8^{th} and 12^{th} weeks after germination (Table 5). The results show that the plant growth (4^{th}, 8^{th} and 12^{th} week) didn't show a significant different in number of leaves per plant across treatments. The growth of leaves and plant height retarded due to shortage of rainfall from the time of planting.

Lablab yields as affected by field margin pesticidal plants

Table 6 shows high yields was observed in field margin plots compared to no field margin, this may results to the power of field margins with pesticidal properties to attract more pollinators hence pollination process become more effective, also natural enemies found in field margins control insect pests which feed on crops reduced. The field margins contributed to lower the number of insect pests hence improved pollination.

The study indicated increase in yields in the plots surrounded by the field margin compared to no field margin. The increase in yield may have been caused by low insect pests on those plots due to the botanical pesticidal plants preserving the natural enemies due by providing shelter to them. In the sprayed field margin had more yield than no sprayed field margin. The sprayed field margin had more yield 222.7 kg/ha compared to no sprayed field margin 129.8 kg/ha, this might due to sprayed treatment had less insect pests compared to other treatments as shown in table 7.

.It was observed that interaction of pesticidal plants in the field margin and use of botanical pesticides can be the best way to control insect pests while conserve the environment because no chemical residues effects. It is good thing that the botanical pesticides can be prepared early in powder or liquid form and stored for future use as it is practised for synthetic pesticides, which are common ways used by farmers to control pests by using synthetic pesticides. The practice of preparing and storing botanical pesticides for future in control pests has been practiced by some few farmers in Tanzania. This practice can be adopted by other farmers as these pesticidal plants are widely available in different agro ecological zone.

Diversity (mixture) of field margin helps to attract more natural enemies as the plants grow differently. The chemical compounds which they release will attract different types of natural enemies. The field margins will also contribute to attract pollinators which are much needed to complete the fruiting process of the crops. The study showed many pollinators (especially bees) were observed on the flowers of the field margins and hence facilitating pollination in the adjacent crops (lablab).

The study verified that field margin with pesticidal plants were effective in attracting natural enemies [18], minimizing incidents and severity of foliage pest damage and contributing more to the growth and yield parameters. The treatments which had field margin plants with pesticidal properties attracted more natural enemies than the treatments without them. Those natural enemies contributed to reduce the number of insect pests; hence the yield was high compared to others which didn't have field margin plants with pesticidal properties [19].

5. Conclusions

From the findings, it is concluded that the use of field margins with pesticide properties is a sustainable way in agriculture production. This paper contributes to the knowledge of controlling pests in a way which does not pollute the environment.

6. Recommendations

Therefore, it is recommended to farmers use to field margin pesticidal plants to influence natural enemies hence control of pests improved naturally without application of pesticides as farmers normally do. Also it is recommended to researchers to carry out more studies on which effective distance from pesticidal plants can contribute to spread the natural enemies throughout the field.

Table 1: Effect of field margin pesticidal plants versus no field margin 4th week one day before application of pesticide

Treatment	Insect				
	Spined soldier bug	Aunt	Parasitoid Wasp	Spider	Blister beethe
Plot with field margin pesticidal plants in the centre	0a	0a	0a	0a	0.33a
Plot with field margin pesticidal plants in the edge	0a	0a	0a	3b	0a
Plot without field margin pesticidal plants in the centre	0a	0a	0a	0.33a	0.33a
Plot without field margin pesticidal plants in the edge	0a	0a	0.33a	1a	0.67a

*Different letters within the same column mean significantly different at P = 0.05 as determine by Tukey's Test.

Table 2: Effect of field margin pesticidal plants versus no field margin week 4 one day after application of pesticide

Treatment	**Insect**				
	Spined soldier bug	**Aunt**	**Parasitoid Wasp**	**Spider**	**Blister beetle**
Plot with field margin pesticidal plants in the centre	0a	0a	0.1a	0a	0a
Plot with field margin pesticidal plants in the edge	0.33a	0a	1.333b	0.33a	0a
Plot without field margin pesticidal plants in the centre	0a	0a	0.667ab	0.3a	0.33a
Plot without field margin pesticidal plants in the edge	0a	0a	0.33ab	1a	0a

Different letters within the same column mean significantly different at P = 0.05 as determine by Tukey's Test

Table 3: Effect of field margin pesticidal plants versus no field margin week 8

Treatment	**Insect**				
	Spined soldier bug	**Aunt**	**Parasitoid Wasp**	**Spider**	**Blister beethe**
Plot with field margin pesticidal plants in the centre	0a	0a	2b	0a	0a
Plot with field margin pesticidal plants in the edge	0a	1ab	0a	2a	0a
Plot without field margin pesticidal plants in the centre	0.33a	0a	0a	0a	0a
Plot without field margin pesticidal plants in the edge	0a	0a	0.33a	1a	0a

Different letters within the same column mean significantly different at P = 0.05 as determine by Tukey's Test.

Table 4: Effect of field margin pesticidal plants versus no margin week 12

Treatment	**Insect**				
	Spined soldier bug	Aunt	Parasitoid Wasp	Spider	Blister beetle
Plot with field margin pesticidal plants in the centre	0a	0a	2b	0a	0.667a
Plot with field margin pesticidal plants in the edge	1a	1a	0a	2a	0a
Plot without field margin pesticidal plants in the centre	1a	0a	0a	0a	2a
Plot without field margin pesticidal plants in the edge	0a	0a	0.33a	1a	1.67a

Different letters within the same column are significantly different at P = 0.05 as determine by Tukey's Test.

Table 5: Effect of field margin pesticidal plants versus no margin on Growth Parameters of Lablab

Treatment	Week 4		Week 8		Week 12	
	Plant height	No of leaves	Plant height	Number of leaves	Plant height	Number of leaves
Plot with field margin pesticidal plants	11.2a	4.9a	18.4a	15.7a	28.9a	20.7a
Plot without field margin pesticidal plants	15.7a	5.6a	21.3a	14.6a	29.7a	18.9a

Different letters within the same column mean significant difference at P= 0.05 as determine by Tukey Test.

Table 6: Effects of Field Margins with Insecticidal Plants versus No field margin on the Yield of Lablab

Treatment	Number of pods per plant	Number of seeds per pod	100 seed weight (g)	Yield (Kg/ha)
Plot with field margin pesticidal plants	30.1b	1.3a	14b	129.84b
Plot without field margin pesticidal plants	27.2a	1.1a	10a	115.49a

Different letters within the same column mean significant difference at P= 0.05 as determine by Tukey Test

Table 7: Effects of Field Margins with Insecticidal Plants sprayed versus no sprayed on the Yield of Lablab

Treatment	Number of pods per plant	Number of seeds per pod	100 seed weight (g)	Yield (Kg/ha)
Treated (by spraying Tephrosia vogelii 10w/v (+0.1% soap during extraction) plot with field margin pesticidal plants	45.33b	1.667a	23b	222.70b
Treated (by spraying karate) plot with field margin pesticidal plants	49.33c	2.33a	35c	262.4c
Untreated plot with field margin pesticidal plants	30a	1.333a	14a	129.8a

Different letters within the same column mean significant difference at P= 0.05 as determine by Tukey Test

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