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RESEARCH ARTICLE

AGROECOLOGICAL CONTROL OF WEEDS IN COCONUT PLANTATIONS (COCOS NUCIFERA L.) THROUGH THE USE OF GREEN FERTILIZERS

Edgar Enrique Sosa-Rubio, Matilde Cortazar-Ríos, María del Carmen Zavaleta Córdova and Gilbert Herrera Cool

Chetumal Experimental Field, Km 3.5 Chetumal-Bacalar Highway, Chetumal, Quintana Roo, Mexico. CIRSE. INIFAP, 2 Huimanguillo Experimental Field, INIFAP.

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Abstract

The objective of this study was to evaluate the effects of the use of green manures on weed control in coconut plantations of the Yellow Malay Dwarf variety. The study was carried out in a 19-year-old Malayan Yellow Dwarf coconut plantation with an 8 m staggered topological design and under rainfed conditions. It is located in the Chetumal Experimental Field, Quintana Roo, between parallel 18° 30' of LN and meridian 88° 29' of LW, under the influence of a warm sub humid climate, where an annual precipitation of 1,300 mm and a temperature average annual temperature of 26 °C. In the trial, six treatments were evaluated: coconut without cover, as a control treatment (T1); coconut + Gliricidia sepium (T2); coconut + Leucaena leucocephala (T3), coconut + Canavalia ensiformis (T4); coconut + Tithonia diversifolia (T5) and coconut + Clitoria ternatea (T6). The distribution of treatments was carried out using a completely randomized block design, with five repetitions. The variables evaluated werepercentage cover and weed population (# of plants/m2). Analysis of variance was performed for the variables studied and Tukey's test to determine the multiple difference of means ($P<0.05$). The SAS 9.3 statistical package was used to manage the data. You can see the rapid growth and greater coverage at 12 weeks of age, presented by the legumes Clitoria ternatea and Canavalia ensiformis, as well as the Asteraceae Tithonia diversifolia (95, 84 and 93% respectively), and compared to the legumes Leucaena leucocephala and Gliricidia sepium with valuesof 45 and 60%, respectively ($p\leq0.05$). Differences ($p\leq0.05$) were found for weed population between the studied treatments; the highest number of weeds was observed in treatments 1 and 2 with values of 68 and 59 (# of plants/m2), with no difference found between them ($p\geq0.05$), but compared to treatments T3 and T4 ($p\leq0.05$).) that presented values of 49 and 40 plants/m2 respectively.

Introduction:-

The cultivation of the coconut tree is of high importance due to the jobs it generates and because it is mostly cultivated by small farmers (Cortazar and Carrillo, 2009; Gurr et al., 2016)) in addition tothe products and by-

Corresponding Author:- Edgar Enrique Sosa-Rubio
Address:- Chetumal Experimental Field, Km 3.5 Chetumal-Bacalar Highway, Chetumal, Quintana Roo, Mexico. CIRSE. INIFAP, 2 Huimanguillo Experimental Field, INIFAP.

products obtained from it are abundant, healthy and environmentally friendly. The Yucatan Peninsula has approximately 2,000 hectares planted with coconut trees, interest in this crop is increasing, due to the opportunity it represents for the exploitation of highly profitable products such as water and coconut oil; In Q. Roo, around 10,000 coconuts are processed weekly. The best conditions for the development of the coconut tree occur in regions with high soils, temperatures and humidity that favor the exuberant development of weeds, which unfortunately strongly affects the productivity of the crop. Coconut plantations are invaded by a wide range of perennial and annual weeds that compete with the coconut tree for water and nutrients, affecting its growth and production. In addition, weeds make field operations such as fertilizing, harvesting and internal transportation of the crop difficult. Certain weed species are known to act as pest hosts and attract rats and other vertebrate pests. Studies carried out in the vegetation surrounding coconut plantations in Jamaica reported weed species hosting phytoplasmas directly related to the transmission of the etiological agent of Lethal Yellowing with asymptomatic characteristics (Oropeza et al 2010). These authors also determined that the weed species located in the understory could be considered as natural hosts of phytoplasmas (Wisler and Norris, 2005). Therefore, weed management is an essential cultural practice for host control in coconut cultivation (Ramos et al., 2018). The most critical period of competition with the crop is from planting to 5 years. A high weed infestation can reduce young plant growth by up to 64%. On the contrary, the degree of weed competition with the crop is lower in mature plantations; there are reports that show a 14% reduction in coconut yield due to high weed infestations. Therefore, the producer must pay greater attention to weed management in young plantations than in mature ones. Weeds can be controlled by mechanical, cultural, chemical and biological methods. Producers frequently use residual and selective herbicides that are characterized by inhibiting the photosynthesis of susceptible weeds, achieving their suppression (Mallory-Smith and Retzinger, 2003).The ecological impact of this activity is quite high and includes infertile soils, contamination of groundwater, soil loss and recycling of organic matter. An agro ecological practice that can support weed control and reduce production costs, in addition to providing nutrients to the soil, is the use of covers with green manures in coconut plantations. Legume cover crops are recognized for providing multiple benefits when associated with other crops. Although its contribution to the improvement of the physical and chemical properties of soils is known, its establishment goes further, favoring several dimensions of a production system, such as the health and nutrition of the associated crop (Ruíz and Molina, 2014). . In the spaces between the palms, manual weeding is practiced or cover crops such as kutzú, centrosema and other legumes and asteraceae are established. Due to the aforementioned, the objective of the present study was to evaluate the effects of the use of green manures on weed control in coconut plantations of the Yellow Malay Dwarf variety.

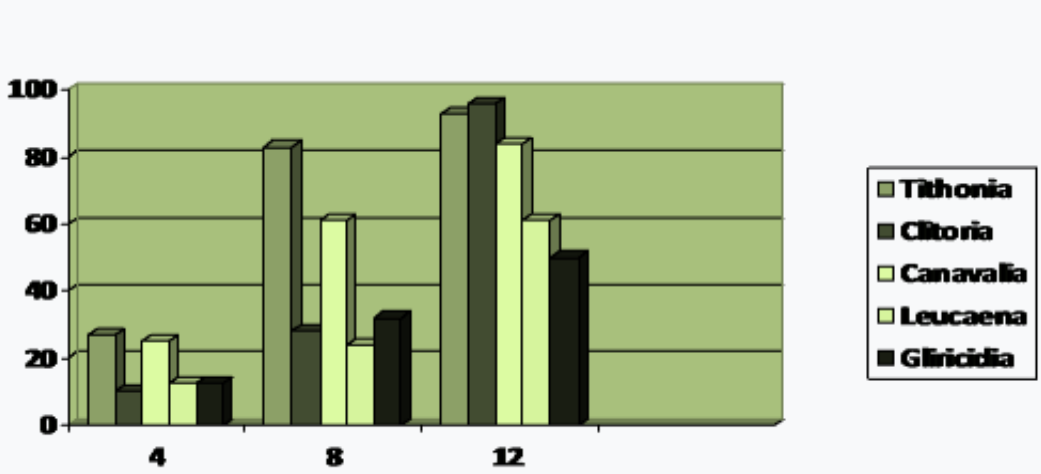
Materials and Methods:-

The study was carried out in a 19-year-old Malayan Yellow Dwarf coconut plantation with an 8 m staggered topological design and under rainfed conditions. It is located in the Chetumal Experimental Field, Quintana Roo, between parallel 18° 30' of LN and meridian 88° 29' of LW, under the influence of a warm sub humid climate, where an annual precipitation of 1,300 mm and a temperature average annual temperature of 26 °C. The type of soil where it is found is a transition between a vertigo gleysol soil and a chromic luvisol, which has a regular to high clay content and, consequently, its drainage ranges from slow to moderate. Since 2018, the application of four treatments on coconut palms began: In the trial, six treatments were evaluated: coconut without cover, as a control treatment (T1); coconut + Gliricidia sepium (T2); coconut + Leucaena leucocephala (T3), coconut + Canavalia ensiformis (T4); coconut + Tithonia diversifolia (T5) and coconut + Clitoria ternatea (T6). The legumes and Asteraceae were planted on the coconut row. For the planting of the legumes, the land was prepared in a conventional way with a harrow and furrow pass, to eliminate the vegetation present. When planting Gliricidia and Tithonia diversifolia, vegetative material was used 30 cm long and 2.5 cm in diameter, from mature branches, greenish brown in color, with diameters of 4 to 12 cm. The planting of the cuttings was carried out at a depth of 20 cm at the beginning of the rains, after applying hormones (rooting agent) in order to ensure establishment. The planting arrangement was 8 plants between coconut and coconut, distributed in two rows of four plants each, starting 2.5 m from the stem of the coconut palm, the distance between plants was 1 m. Botanical seed of the Cunningham variety was used for sowing Leucaena; The planting arrangement was the same as that of Gliricidia, the planting depth used was 2 to 4 cm. For sowing Clitoria and Canavalia, botanical seed was also used, previously scarified with water at 70 °C for a period of 3 to 5 minutes. Sampling was carried out at 4, 8, and 12 weeks after sowing, in the period of maximum precipitation. The experimental plot consisted of six coconut palms; the distribution of the treatments was carried out using a completely randomized block design, with five repetitions.The variables evaluated were percentage cover and weed population (# of plants/m2). Analysis of variance was performed for the variables studied and Tukey's test to determine the multiple difference of means ($P<0.05$). The SAS 9.3 statistical package was used to manage the data.

Results and Discussion:-

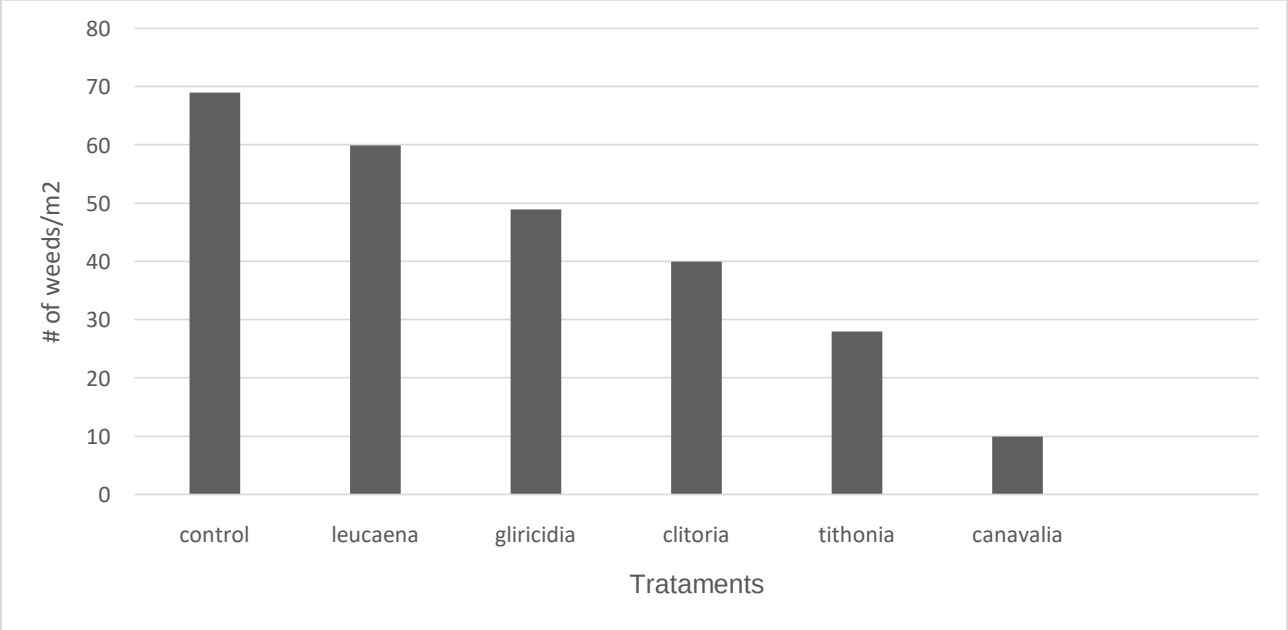
The results obtained indicated that during the beginning of the cultivation of green manures it is necessary to eliminate the first generation of weeds in order to allow the initial growth of the manures.

No se observó diferencia ($p \geq 0.05$) entre tratamientos para cobertura a las 4 semanas posteriores a la siembra. En la gráfica 1 se puede observar el rápido crecimiento y la mayor cobertura a las 12 semanas de edad, que presentaron las leguminosas Clitoriaternatea y Canavaliaensiformis, así como la Asterácea Tithoniadiversifolia (95, 84 y 93 % respectivamente), en comparación a las leguminosas Leucaenaleucocephala y Gliricidiasepium con valores de 45 y 60%, respectivamente ($p \leq 0.05$).



Graph 1:- Percentage of coverage of legumes and Asteraceae at different ages.

This allowed greater foliage production and greater weed control. These species, according to their growth and coverage, are important to consider to be established in the alleys, which would allow increasing the contribution of dry matter and nutrients to the soil.



Graph 2:- Number of weeds/m2 in coconut trees with different green fertilizers.

Differences ($p \leq 0.05$) were found for weed population between the studied treatments; the highest number of weeds was observed in treatments 1 and 2 with values of 68 and 59 (# of plants/m2), with no difference found between them ($p \geq 0.05$), but compared to treatments T3 and T4 ($p \leq 0.05$).) that presented values of 49 and 40 plants/m2 respectively; Ramirez et al., (2001)observed similar results when using Canavalia in corn production, since this legume controlled weeds better according to the number of plants/m2. Senarathne et al., (2003), evaluating for four years the influence of five different weed management systems in coconut crops (Cocus nucifera L), including the introduction of legume covers, found, among the main results, that the use Coverage with P. phaseoliodes effectively reduces weed density. The best treatments observed were T5 and T6, which presented the lowest values of weeds per m2, with values of 28 and 10, respectively; It should be noted that these two species have a very rapid establishment, because in the case of Canavalia its seeds are large, which allows it a large amount of reserves for its initial growth, which is not the case for the seeds of Leucaena and Clitoria, which have a very small size and once they germinate, their reserves are depleted and they depend on the photosynthetic capacity of the developing foliage to continue their growth, with their establishment or ground cover being slower as mentioned by Enríquez et al., (2021) using legumes for weed control in Limón. In Tithonia, a much faster development of foliage could be observed compared to Gliricidia, although both were established with branches of the same age and size, which allowed it to cover the ground faster and reduce the number of weeds. In coconut palm plantations, legume covers decreased the incidence of Sorghum halapense (Johnson grass) infestation by providing dense cover over potential seed dispersal sites such as the spaces between palms and corridors.These data agree with research reports where the species Mucuna pruriens and Clitoria ternatea have been used as green manure and plant cover, observing their greatest benefits in the fixation of atmospheric nitrogen to the soil, weed control, moisture retention and reduction of erosion (Gerónimo et al., 2002; Bustamante and Campos, 2004).

Table 1:- Comparison of means of variables related to the presence of weeds using green fertilizers for their control. Chetumal Experimental Field, Quintana Roo, Mexico.

Tratamiento	No. de arvenses en 1 m^2	No. de especies	No. especies hoja angosta	No. especies hoja ancha
T1	68.20^{a}	10.10^{a}	2.02^{a}	8.00^{a}
T2	59.50^{a}	9.50^{a}	2.10^{a}	7.40^{ab}
T3	49.00^{b}	6.70^{ab}	3.20^{b}	3.10^{b}
T4	40.30^{b}	6.80^{b}	3.40^{b}	3.40^{b}
T5	28.30^{c}	3.07^{c}	1.12^{c}	2.0^{c}
T6	10.45^{c}	3.01^{c}	1.01^{c}	2.0^{c}

Means with different letters in each column are statistically different (Tukey, $P \leq 0.05$).

In Table 1 you can see differences between treatments ($p \leq 0.05$) for the variables under study. The greatest number of species could be observed in the control treatment (T1) and T2, compared to the rest of the treatments. The largest number of weed species observed in this study were broad-leaved, which agrees with what Martín (1984) who indicates that, given the temperature and humidity conditions present in the study site, it allows the development of many broadleaf mentioned and narrowleaf weed species.

In the conditions where the trial is located, different types of weeds grow, but the weed species that were reported with the greatest presence were Malvastrum sp., Ipomoea sp., Rottboellia cohinchinensis (walker), Sorghum halapense (Johnson grass), Eleusine indica (hen's foot), Cyrus rotundas L and Imperata cylindrica (L.) Raeuschel.Cyperus rotundus (nutsedge), Paspalum conjugatum.

Conclusions:-

The results found in the present study allow us to conclude that the best treatments were the Asteraceae Tithonia diversifolia and the legume Clitoria ternatea for weed control in coconut areas.

In addition, they are an agro ecological alternative in the coconut production system with characteristics of sustainability and environmental conservation.

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