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Research Article

Influence of Intercropping on Weed Control, Soil Fertility and Forage Quality

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ABSTRACT

Intercropping is the practice of growing two or more crops together in a single field. The main purpose of intercropping is to produce a greater yield on a given piece of land by making use of resources that would otherwise not be utilized by a single crop efficiently. Legume intercropping systems play a significant role in the efficient utilization of resources. Nowadays so many intercropping and the results of some studies also have shown that in the intercropping compared to monoculture to more effectively use resources and therefore decrease the amount of available resources for weed. Cereal – grain legume intercropping has potential to address the soil nutrient depletion on smallholder farms. The legumes play an important role in nitrogen fixation and are important source of nutrition for both humans and livestock. In the central highlands of Kenya, cereal – legume intercropping is already being widely practiced by the smallholder famers.

Key words: Cereal, Legume, Yield advantage, Moisture

INTRODUCTION

Intercropping is the practice of growing two or more crops together in a single field. The main purpose of intercropping is to produce a greater yield on a given piece of land by making use of resources that would otherwise not be utilized by a single crop efficiently. Legume intercropping systems play a significant role in the efficient utilization of resources. Cereal-legume intercropping is a more productive and profitable cropping system in comparison with solitary cropping (Evan, 2001). The main subject of intercropping is to augment total productivity per unit area and time, besides judicious and equitable utilization of land resources and farming inputs including labors (Marer, 2007).

Types of intercropping

Compared with pure cropping in which one species is planted, intercropping is consisting planting of two or more crops. Intercropping can be included: annual plants with annual plants intercrop; annual plants with perennial plants intercrop; and perennial plants with perennial plants intercrop (Eskandari *et al*., 2009a; Ghanbari and Lee, 2003) The intercropping is divided into the following four groups (Vandermeer, 1992; Ofori and Stern, 1987).

Strip intercropping

Between different intercropping methods the strip intercropping is considered an efficient method for massive field culture and production that if administered well permits use of machinery and mechanization in cropping, maintenance and harvesting and therefore increases economical potential and decreases use of fertilizes and insecticide and diminishes soil erosion especially in slops (Cruse, 1992; Hayder *et al*., 2003). In the strip intercropping different plant are sewed in strips but in the same field. Strip width has to be set in a way that easy mechanization and plant interactions are achieved. This intercropping methodology is common in most of developed countries and leads to a higher yield stability, soil fertility and decreased nutrients loss along with decreased pests and weeds and plant diseases (Hauggaard-Nielsen *et al*., 2007; Marchiol *et al*., 1992; Leosing and Francis, 1999).

Weed control by intercropping

Nowadays so many intercropping and the results of some studies also have shown that in the intercropping compared to monoculture to more effectively use resources and therefore decreases the amount of available resources for weed. On the other hand, Intercropping with

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shading. Choke and allopathic properties to prevent the growth of weed different species (Zimdahl, 2007; Asgharipour and Rafiei, 2011). In intercropping of two Mentha and scented geranium (*Pelargonium ssp*.) Weed dry weight was lower than in pure culture plants (Rajsawara, 2002). The results of the survey on the impact of strip intercropping row and bean (*Phaseolus vulgaris*) seeds and basil (*Ocimum basilicum L*.) showed that intercropping reduced the weed biomass density (Alizadeh *et al*., 2009). As well in the barley and pea intercropping weed biomass than the monoculture pea drop (Santiago and Poggio, 2005). Also Abraham *et al* (1984) in a study of intercropping sorghum - Chshmblbly forage beans. green gram - Cowpeabean seed, peanut and soybean observed that all intercropping shave to prevent the growth of weeds, Eskandari (2004) in maize and bean intercropping for forage reported that the dry weight of weeds in intercropping and monoculture corn and beans was less than in pure culture. The intercropping of cowpea with sorghum was observed, the number of weed species was affected by irrigation levels and planting patterns. The least number of weed was achieved in control treatment and weeds significantly compared to pure sorghum (no weeding) decreased (SanJani *et al*., 2009). Also with increasing additive intercropping barley and faba bean densities were effectively controlled the weeds (Agegnnehu *et al*., 2007). Biomass production and less density of weeds in intercropping crops in the supplementation is mixed that Increase their competitive ability with weeds to waste was reduced (Nielson *et al*, 2003) in intercropping Wheat and chickpea density and biomass weed significantly decreased Thus, compared to a wheat net in intercropping 69/7 percent weed biomass and weed density was reduced by 70 percent (Banik *et al*., 2006) in intercropping of maize and squash, weeds control of intercropping was more effective than monoculture corn (Ghanbari *et al*., 2010). Researchers expressed in intercropping Remarkably, the amount of weeds decreased (Daraiimofrad *et al*., 2008). In intercropping corn and cucumber control and management of weeds in comparison with a pure culture of excellence demonstrated (Ghanbari *et al*., 2006). Nesting in intercropping with increasing diversity is less biomass in weed less and therefore the number of weeds per unit area decreases (Javanshir *et al*., 2000; Asgharipour *et al*., 2011). This type of uniform crop of weeds by reducing the relative abundance of dominant weed population changes (Poggio, 2005). Salmon (1990) showed that during the 30 days after planting, intercropping of maize and beans. Beans well and can cover the space between rows of planted corn to control weeds, as well. Samarajeewa *et al.* (2006) have reported soybean cultivation with millet crop due to high tillering ability is able to significantly prevent the growth of weeds and reducing their population to be effective. Tollennar *et al.* (1994) Effect of weed competition and soil nitrogen on four maize hybrids was investigated. They found that the effect of weeds on the hybrid low nitrogen levels were higher. Significantly interaction between hybrid and nitrogen levels, they concluded that the hybrid selection and appropriate levels of nitrogen can have a great effect on weed control. Hakansson (1993) with study on the competitiveness weeds and crops. Factors affecting competition between plants that are dependent on time and space can be defined as follows : A) plant density b) horizontal distributionc) the relative time emerged plants He noted that the interaction of these factors for the outcome of competition between species and within species is an unavoidable product. Any change in one species to another species would drastically change the situation and why intercropping yield changes. Weeds reduce crop yield is the sum competition. Intercropping have more competitive on weeds and in stress applied weeds are more pronounced than in intercropping of beneficial monoculture. Abraham (1984) reported when in intercropping with sorghum. Plants such as beans cowpea (seed) greenmung bean. Peanut and soybean were added to increase the yield and sorghum nitrogen content and weed control pollution were pure sorghum. Majnoun Hosseini and kolar (2008) Effect of culture Hindi - mung bean found that, mung bean planting a row in Hindi lines because weeds were choking. They also planted two rows of mungbean Hindi lines to achieve results that weed control is done efficiently.

Soil fertility

Cereal – grain legume intercropping has potential to address the soil nutrient depletion on smallholder farms (Sanginga and Woomer, 2009). The legumes play an important role in nitrogen fixation (Peoples and Craswell, 1992), and are important source of nutrition for both humans and livestock (Nandwa *et al*., 2011). In the central highlands of Kenya, cereal – legume intercropping is already being widely practiced by the smallholder famers. According to Sanginga and Woomer (2009) intercropping cereal and grain legume crops helps maintain and improve soil fertility, because crops such as cowpea, mung bean, soybean and groundnuts accumulate from 80 to 350 kg nitrogen (N) ha-1 (Peoples and Craswell, 1992). For instance, soybean can positively contribute to soil health, human nutrition and health, livestock nutrition, household income, poverty reduction and overall improvements in livelihoods and ecosystem services, then many others leguminous grain crops (Rakasi, 2011; Raji, 2007). According to Willey *et al*. (1979) for plants to derive benefits from intercropping, inter specific competition for growth factors should be lower than intra specific competition in single stands. In a legume-cereal combination, the legume may suffer from competition depression especially when combined with C4 cereals like maize under high soil fertility conditions. On the other hand, the growth and yield of the cereal may be reduced under low soil fertility conditions where the legume has competitive advantage over the cereal. According to Ikisan, (2000) the groundnut plant has a universal ability to utilize soil nutrients that are relatively unavailable to other crops and is very effective in extracting nutrients from sandy soils of low nutrient supply.

Forage quality

Monocultures of legumes or cereals do not provide in some cases satisfactory results for forage production (Osman and Nersoyan, 1986). In particular, forage quality of cereals is usually lower than that required to meet satisfactory production levels for many categories of livestock. Small grain cereals provide high yields in terms of DM (dr matter) but they produce forage with low crude protein (CP) (Lawes and Jones, 1971). In intercrops, companion cereals provide structural support for legume growth, improve light interception, and facilitate mechanical harvest, while legumes generally increase the protein and mineral content of forage (Robinson, 1969). Crop species, seeding rates, and competition between mixture components may affect yield and quality of forage produced by intercrops (Caballero *et al*., 1995).

Cereal-legume intercropping

Legume intercropping systems play a significant role in the efficient utilization of resources. Cereal-legume intercropping is a more productive and profitable cropping system in comparison with solitary cropping (Evan *et al*., 2001). Legumes, in addition to secure beast nutrition which used as grazing and lay harvesting, had strong roots that penetrated soil and helped to amendment and increase soil mass and microorganisms, also having symbiosis relationship with rhizobium bacteria in intercropping could produce much part on nitrogen that grasses used (west and wdine, 1985). Having adventure roots, grasses need nitrogen for growth fast. If legumes produce good nodule in intercropping, much parts of nitrogen that grasses need was available (Ibrahim and kabesh, 1971). Maize + legume intercropping was found more productive and remunerative compared to sole cropping according to Li *et al*., (2003). Cereal -legume intercropping systems are able to lessen amount of nutrients taken from the soil in comparison to a maize monocrop (Tsubo *et al*., 2003). This means less nutrients are lost and more water is available for crop growth. Intercropping of cereal and legume crops helps maintain and improve soil fertility (Andrew, 1979). Salc and alberscht (1996) states that intercropping of medicago sativa with luliom had more ley yield than single cropping and more yield was seen in early variety of luliom in intercropping albeit of lower crude proteins. Wholly much more researches showed that the leys of intercropping in addition to produce stable lay in year, is more that single cropping.

Yield advantage of mixed cultivars

Intercropping is defined as the intensification and diversification of cropping in time and space dimensions (Francis, 1986). The suggested advantages of this cropping system include yield stability under adverse environmental conditions, efficient use of limited growth resources, biological diversity, and potential control of pests and diseases. Many concepts have been developed to assess yield advantages as a result of the divergent production goals of different intercropping systems which include; land equivalent ratio (LER) and relative yield total (RYT) (Willey, 1990). Intercropping of cereals with legumes has been popular in humid tropical environments (Tusbo *et al*., 2005) and rain-fed areas of the world (Gosh *et al*., 2004) due to its advantages for yield increment, weed control (Poggio, 2005), insurance against crop failure, low cost of production and high monetary returns to the farmers (Ofori and Stern, 1987), improvement of soil fertility through the addition of nitrogen by fixation and transferring from the legume to the cereal (Gosh *et al*., 2006), improving yield stability, socio-economic and some other advantages (Willey, 1979). Intercropping being an agricultural practice can be used for decreasing the dependency on chemical herbicides in weed control (Banik *et al*., 2006) and defined as the growing of two or more crop species simultaneously in the same field during a growing season (Ofori and Stern, 1987). Intercropping generates beneficial biological interactions between crops, increases grain yield and stability, helps use the available resources more efficiently and reduces the weed pressure (Jensen, 2007). The intercropping may lead to an overall yield advantage (Sayed Galal *et al*., 1979; Ahmed and Rao, 1982; Sayed Galal, 1983 & 1984; Assey *et al*., 1992a&b; Shafik, 1995 & 2000; Metwally, 1999 and Shafik and Soliman, 1999). Many studies have shown that intercropping system out yielded monocultures of component crops (Baumann *et al*., 2001; Lesoing and Francis, 1999; Ghaffarzadeh *et al*., 1997; Fortin *et al*., 1994; Mandal *et al*., 1990). However, some potential disadvantages associated with intercropping often have limited its practicing to low-input and small-scale agricultural systems. The disadvantages are related mainly to use of agricultural machineries especially when the component crops have different requirements for planting pattern, fertilizer, herbicides among other factors. A yield advantage of mixed cultivars has been observed in various crops including barley (Jokinen, 1991; Valentine, 1982), oat (Qualset and Granger, 1970; Grafius, 1966), flax (Gubbles and Kenachuk, 1987), small grain cereals (Juskiw *et al*., 2000) and soybean (Schweitzer *et al*., 1986; Wilcox and Schapaugh, Jr., 1978; Wilcox, 1985). The superiority of mixed cultivars over pure stands has been attributed generally to the significant variations of morphological characteristics including root system, plant height, and leaf orientation which result in efficient exploitation of environmental resources, specifically light interception. Increased lodging resistance (Grafius, 1966), improved disease resistance (Wolfe, 1985), and better weed control (Jokinen, 1991) also have been reported. Some investigators have concluded that the advantage of intercropping of cultivar mixtures depends on plant population density (Herbert *et al*., 1984; Putnam *et al*., 1985; Putnam *et al*., 1986).

Radiation interception and moisture use

Light, water and nutrients may be more completely absorbed and converted to crop biomass by intercropping, which is the simultaneous growing of two or more crop species in the same field. This is a result of differences in competitive ability for growth factors between intercrop components (Anil *et al*., 1998; Amini *et al*., 2013). Solar radiation is the major resource determining growth and yield of component crops of intercrops when other growth resources are not limiting. Canopy structure is not only essential to describe radiation interception but also precipitation interception, evapotranspiration and crop productivity. Improved productivity can result from greater interception of solar radiation, higher light use efficiency, or a combination of the two (Willey, 1990). Arya and Niranjan (1995) indicated that maximum moisture of 10.4 per cent was recorded under sorghum + fodder cowpea with a farm yard manure 6 tons per ha, followed by sorghum + fodder cowpea with 50 per cent inorganic fertilizer (N 30 + P 8.8 kg/ha). Integration of legume either in sole or in the intercropping systems has the potentiality to extract more moisture from deeper soil surface. This article is review and the aims of influence of intercropping on weed control, Soil fertility and forage quality.

MATERIALS AND METHODS

This article is review and the aims of I Influence of intercropping on weed control, Soil fertility and forage quality. The experiment 1 was conducted by Nasrollahzadeh *et al.* (2014). The climate of research area is characterized by mean annual precipitation of 285 mm, mean annual temperature of 10°C, mean annual maximum temperature of 16.6°C and mean annual minimum temperature of 4.2°C. The experiment was arranged in a Randomized Complete Block Design, with three replications and two treatments. The treatments were represented by the following; different planting patterns treatment: a1, a2, a3, a4, a5 and a6: respectively, pure stand of chickpea, pure stand of Dragon's head, additive intercropping of optimal density of chickpea + 25, 50, 75 and 100% of optimum density of Dragon's head. Four time of weeds control levels were; b1, b2, b3 and b4: complete control, no weeds control, control after 2-4 weeks after emergence, control after 5-7 weeks after emergence. All plots were irrigated immediately after sowing (Nasrollahzadeh *et al.*, 2014). To specify plant heights, number of capsule per main and lateral stem and lateral stem number ten plants were selected from the middle of the plots and then, they were measured. Also to determine of grain yield and biological yield an area equal to 1 m2 was harvested from middle part of each plot considering marginal effect. Harvested plants were dried in 25°C and under shadow and air flow then grains were separated from their remains by threshing (Nasrollahzadeh *et al.*, 2014).

RESULTS AND DISCUSSION

The experiment 1 was conducted by Nasrollahzadeh *et al* (2014). Statistical analysis of the data indicated that different intercropping patterns and weed management practices had significant effect on plant height of Dragon's head. Maximum plant height (49.8 cm) was obtained in additive intercropping of optimal density of chickpea + 50% of optimum density of Dragon's head under un weeded treatment (a4b2 treatment).

Minimum plant height was recorded in the a2b1 treatment (Figure 1). However, this value was not significantly different from the mean plant height recorded under a4b1 and a5b1 treatments. The canopy characteristics of crops are not constant, but may change due to the presence of other crops species. Maize plants were taller for sole crops compared to when intercropped with beans, both in the presence of weed infestation. In other results, did not find any significant difference in plant height between mono cropping and intercropping of maize with sugar bean and ground nuts (Nasrollahzadeh *et al.*, 2014). Lateral stem of Dragon's head significantly affected by intercropping patterns and weed removal times. Dragon's head plants in the sole cropping system and complete weed controlling treatment produced the highest mean number (3.8 lateral stem in plant) of lateral stem and this was significantly different from the other cropping systems (Figure 2). Additive intercropping of optimal density of chickpea + 100% of optimum planting density of Dragon's head under un weeded treatment a6b2 produced the least lateral stem which was not significantly different from the a5b4, a6b4, a4b2 and a5b2 treatments (Figure 2) (Nasrollahzadeh *et al.*, 2014).

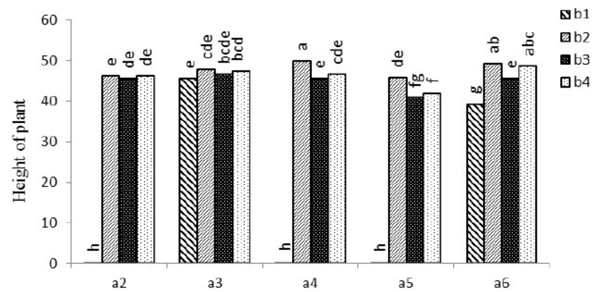

Fig 1: Effect of different patterns of intercropping with times of weed control on height of plant of Dragon's head. a1: pure stand of chickpea, a2: pure stand of Dragon's head, a3: a4, a5 and a6, additive Intercropping of optimal density of Chickpea + 25%, 50%, 75% and 100% of optimum density of Dragon's head. b1: complete control, b2: no weeds control, b3: control after 2-4 weeks after emergence and b4: control after 5-7 weeks after emergence.

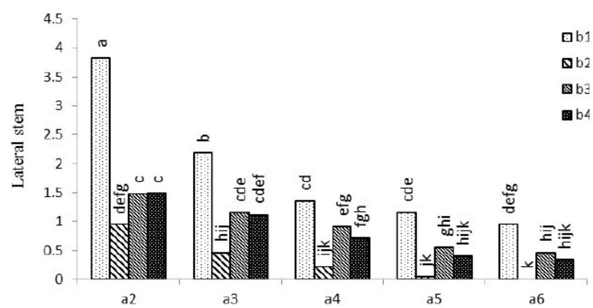

Fig 2: Effect of different patterns of intercropping with times of weed control on lateral stem of Dragon's head. a1: pure stand of chickpea, a2: pure stand of Dragon's head, a3: a4, a5 and a6, additive Intercropping of optimal density of Chickpea + 25, 50, 75 and 100% of optimumdensity of Dragon's head. b1: complete control, b2: no weeds control, b3: control after 2-4 weeks after emergence and b4: control after 5-7 weeks after emergence.

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