

## Effect of intercropping in agronomy

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**ABSTRACT:** 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. 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. Intercropping which is the practice of growing more than one crop simultaneously in alternating rows of the same field. Intercropping being a unique property of tropical and sub-tropical areas is becoming popular day by day among small farmers as it offers the possibility of yield advantage relative to sole cropping through yield stability and improved yield.

**Keywords:** growth, purpose, forage.

### 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). Maize + legume intercropping was found more productive and remunerative compared to sole cropping according to Li, (2003). Maize-legume intercropping systems are able to lessen amount of nutrients taken from the soil in comparison to a maize monocrop (Tsubo, 2003). Kamanga. (2010) reported that maize-legume intercropping was a more productive system and a less risky technology. Higher crop productivity and efficiency in resource use was observed in maize-bean intercropping systems than in the respective sole cropping (Tsubo, 2003). Intercropping which is the practice of growing more than one crop simultaneously in alternating rows of the same field (Ahmad, 2013; Arif, 2013; Bilalis, 2008; Ennin, 2002) is an effective practice in maize production which not only helps reduce the available space for weed growth but also increase the production per unit area. Moreover, in case of a severe disease or insect attack there are least chances of 100% crop loss, as the same disease or insect can't attack two different crops at the same time in the same field. Corn silage is a high-producing forage crop in the United States, with 2.4 million ha planted and 96.4 million Mg harvested in 2005 (USDA-NASS, 2006). Wisconsin was the top corn silage-producing state in the United States, with 13.6 million Mg harvested from 356,000 ha in 2005 (USDA-NASS, 2006). Corn silage is an important source of forage for dairy cattle in the United States because of its relatively consistent nutritive value, high yield, and high energy density compared with other forage crops (Coors and Lauer, 2001). One limitation to corn silage as a feed for dairy cows is low crude protein (CP) concentration; Darby and Lauer, (2002) reported an average whole corn plant forage CP concentration of 73 g kg<sup>-1</sup> across Wisconsin. To achieve this objective, one of the option is growing plants in mix pattern. Multi-product farming is growing of more than one crop in a farming year and a piece of arable land. Setting of planting date in intercropping planting is far more complex than a single planting, since may contain a mixture of species with different requirements and growing course. Generally by more differences between species as

requirement for environmental factors, the amount of product obtained from a mixture was more than single planting (Pasari, 2000). Egli and Bruening, (2000) stated that delaying the optimum time for planting, lead to decreasing in grain yield. In all treatments of intercropping, corn and soybeans had a complementary competition mode against each other that is the advantage of intercropping than pure cultures of two species. The magnitude of the agro-economic advantages depends upon the type of intercrop (Rao, 1991). Intercropping being a unique property of tropical and sub-tropical areas is becoming popular day by day among small farmers as it offers the possibility of yield advantage relative to sole cropping through yield stability and improved yield (Bhatti, 2006). Potential of raising other crops such as forage legumes and non-legumes in association with major staple food crops like rice could be substantially enhanced through intercropping (Saeed , 1999a). It also helps maintaining the soil fertility, making efficient use of nutrients (Maingi , 2001), ensuring economic utilization of land, labor and capital (Jeyabal and Kuppaswamy, 2001) and controlling pest's population (Epidi, 2008). Aal, (1991) and Raghuwanshi. (1994) also reported a higher LER in intercropping as compared to sole crops. Higher LER in intercropping than monocropping was reported in and maize + groundnut (Mandimba et al., 1995) intercropping system. Other benefits of intercropping are related to the better soil cover, which has advantages for weed control, and leads to reduced erosion and nutrient leaching. Because legumes can rely on atmospheric N, they are less likely to compete for N with the cereal (Fujita, 1992; Fan, 2006). The presence of a cereal, exploiting the soil mineral N, may even stimulate legumes to fix N (Marschner, 1995), although most often shading significantly reduces N fixation (Nambiar, 1983). The integration of legumes in maize-based systems can partially counter N losses through atmospheric N fixation, but basal N application remains indispensable (Jerenyama, 2000; Giller, 2001). Mixtures involving soybean had been reported such as soybean/potato (Okonkwo, 1984), soybean/yam (Okigbo and Greenland, 1976), soybean/sorghum (Hiebsch, 1995), and soybean/maize (Olufajo, 1992). It is on the bases of the symbolic nature of grain legumes and their nutritional value in the diets of Nigerian that soybean is found in mixtures with other crops in most agro – ecological zones of Nigeria (Wahua, 1985; Mc Namara and Morse, 1996; Kalu and Omojor, 1991). There are several possible benefits of intercropping legumes with non-legumes. In terms of land use efficiency intercropping is regarded as more productive than sole cropping. (Andrew and Kassam, 1976). Higher nutrient uptake and better water use efficiency have also been suggested. (Dallal, 1974, Baker and Norman, 1975). LER greater than one indicates that more sole cropped land than intercropped is required to produce a given amount of product. The LER of maize-soybean intercrops ranged from 0.98 to 1.55 in Zambia (Mwipaya, 1990), and 1.2 to 1.8 in Ethiopia (Kidane, 1990). Strip cropping is a form of intercropping used in different climate zones. It protects soil from water and wind erosion and reduces nutrient leaching (Rogobete and Grozav, 2011). In the intercropping system root interaction could increase the root activity and microbial quantity in the rhizosphere (Zhang, 2013). Interspecific interaction between species in the rhizosphere can also affect nutrient availability and uptake in intercropping (Hauggard-Nielsen. 2001, Li. 2010). The merits of intercropping cotton with other plants have been documented by several workers in some countries. Cotton plants have been intercropped with sorghum and Setaria (pigeon pea) in India (Aiyer, 1949), with corn or sorghum in West Africa (Baker, 1979), with corn in North East Brazil (Rao, 1984) and with corn in Egypt (Mohamed, 1986; Kamel, 1990 and Abdel-Malak, 1991). Wide distance between corn hills resulted in more light intercepted by both crops in intercropping cultures than that of narrow distance between hills (Metwally, 2003; 2005a and b). Legumes offer a possible lower-cost alternative to nitrogen fertilizers and purchased protein supplements for improving smallholder dairy production (Mapiye, 2006). Successful utilization of cereals ley legumes in intercropping systems depends on the selection of locally adapted (climate and edaphic) species with good associative ability (Mapiye, 2007). Intercropping has been shown to produce higher and more stable yields in a wide range of crop combinations, while the system is characterized by minimal use of inputs such as fertilizers and pesticides, emphasizing the production of healthy, safe, and high quality food in the context of environmentally sound production. For organic sector, intercropping is considered an effective means of self regulation and resilience of the organic agro ecosystems to meet environmental perturbations in the organic culture practice (Lammerts van Bueren, 2002) Pandita, (1998) obtained higher benefit:cost ratio (1.87) under maize-french bean association in 2:1 row ratio over sole maize (1.72). Alternating strips of corn and alfalfa of three widths (10, 20 and 40 ft.) were compared in a field trial. The 20 ft wide strips had the greatest economic advantage, returning \$6, \$29 and \$17 per acre over sole crops during 1988, 1989 and 1990, respectively (Smith and Carter, 1998). Net profit (Rs. 13822/ha) and B:C ratio (1.75) were higher in intercropping of sorghum and cowpea in 2:1 row ratio than sole sorghum (Thippeswamy, 1999). Birader (2000) reported that when Lucerne was grown as cover crop in cotton at 1:2 row ratio maximum net income (Rs. 55149/ha) and B:C ratio (6.49) were recorded with a cotton plant geometry of 120 cm x 60 cm with 100 per cent recommended dose of fertilizers. Ranbir Singh et al, (2002) reported that maize + okra-potato-clusterbean recorded highest cost of cultivation (Rs. 33500/ha). But, net returns were maximum in maize + cowpeapotato clusterbean cropping system. Minimum cost of cultivation (Rs. 19700/ha) and net returns (Rs. 26781/ha) were under maize-

cauliflower -clusterbean system. Maize + cowpea– cauliflower-clusterbean recorded highest (Rs. 1.71) net returns/rupee invested. Rajshekhar, (2004) reported that the paired row planting of maize along with simultaneous maize-lucerne planting recorded maximum net returns (Rs. 23367/ha). This can be attributed to higher gross income as a result of higher maize equivalent yield. Higher benefit-cost ratio (2.99) was obtained with intercropped paired row planting of maize at 1:1 row proportion with simultaneous planting of maize and Lucerne. Systems that intercrop maize with a legume are able to reduce the amount of nutrients taken from the soil as compared to a maize monocrop. When nitrogen fertilizer is added to the field, intercropped legumes use the inorganic nitrogen instead of fixing atmospheric nitrogen and thus compete with maize for nitrogen. However, when nitrogen fertilizer is not applied, intercropped legumes will fix most of their nitrogen requirements from the atmosphere and not compete with maize for nitrogen resources (Adu-Gyamfi, 2007). Dry bean (*Phaseolus vulgaris*) is a grain legume which has wide range of uses such as human and animal feed, soil improvement through biological nitrogen fixation and green manuring. National Department of Agriculture and ARC-Grain Crop Institute, (2002) reported that dry bean is at present regarded as one of the most important field crops in South Africa on account of its high protein content and dietary benefits for humans. Maize/dry bean intercropping in Limpopo Province plays an important role in food security for SH farmers, particularly in Vhembe District. According to Hudgens (1996), although intercropping of maize/dry bean is efficient for food security, dry bean is believed to fix too little atmospheric nitrogen, thus intercropping still requires large amount of nitrogenous fertilizers for maize to thrive well. It is known that indeterminate dry bean cultivar fix more nitrogen than determinate types. Plant population is the important factor in intercropping of legume-maize as it can determine the extent of competition between intercrops (Fisher, 1977; Kgasago, 2006). Factors such as moisture availability, soil fertility status and cultivars to be planted determine the plant population to be planted in the specific area (Molatudi and Mariga, 2012). Different intercropping systems have been evaluated, including mixed intercropping, strip cropping, and traditional intercropping arrangements. The main concept of intercropping is to get increased total productivity per unit area and time, besides equitable and judicious utilization of land resources and farming inputs including labour (Marer, 2007). Ahmad, (2001) concluded that soybean can successfully be intercropped with maize for an efficient use of land. Limited availability of additional land for crop production, along with declining yield per unit area have heightened concerns about introduction of cropping systems which are sustainable and economically viable. A possible way of increasing the productivity would be through multiple cropping systems like intercropping which is one of the options to feed more mouths. Intercropped legumes fix most of their nitrogen from the atmosphere and not compete with maize for nitrogen resources (Adu-Gyamfi et al. 2007 and Vesterager. 2008). At present in Pakistan maize occupies third position after wheat and rice and 98% of the crop is grown in Punjab and NWFP Pakistan grows maize on about 1.11 million hectares with annual production of 4.04 million tons of grain and average yield of 3.62 tones ha<sup>-1</sup> (Govt. of Pakistan, 2009). Intercropped legume yield in sorghum was significantly higher in 30 cm /90 cm paired row over 30 cm/60 cm paired row planting (Hedge, 1983). The green matter of fodder legumes intercropped with maize (1:1) was 11.74, 12.28, 14.00, 3.08, 4.08 and 8.08 t per ha with cowpea, sunnhemp, dhaincha, black gram, green gram and cluster bean, respectively (Gangwar and Sharma, 1994). The field studies conducted at UAS, Dharwad by Chittapur, (1994) have shown that the fresh weight of legume intercropped for fodder with maize varied significantly. Cowpea recorded the highest phytomass (17.11 t/ha) in 1:2 ratio followed by dhaincha (10.11 t/ha), horsegram (9.1 t/ha), soybean (7.24 t/ha), sunnhemp (6.16 t/ha) and black soya (5.09 t/ha) at 70 days after sowing. Field experiments were conducted in Ontario (Canada) to investigate the effect of sowing date on grain yield of maize sown either in an established *Medicago sativa* sod or bare soil. Grain yield of maize was reduced significantly in delayed sowing of maize compared with May sowing in an established *Medicago sativa* sod (Aflakpui, 1994). A field experiment conducted at Palampur during kharif season revealed that intercropping of soybean, cowpea and velvetbean in sorghum at 60 cm and 90 cm row spacing produced qualitatively better legume at 60 cm row spacing (Sood and Sharma, 1996). Ramaswamy et al, (1996) reported that when maize was intercropped with pigeonpea, blackgram, greengram and cowpea in 1:1, 2:1 or 2:2 row ratio, maize grain yield was highest when intercropped with pigeonpea in 2:1 row ratio. Smith and Carter (1998) reported that alternating strips of corn and alfalfa of three widths (10, 20 and 40 ft) were compared in a field trial. Among the different strips, 20 ft wide strips resulted in significantly higher corn and alfalfa yield.

## MATERIALS AND METHODS

This paper is a review of the literature search on ISI, Scopus and the Information Center of Jahad and MAGIRAN SID is also abundant. Search library collection of books, reports, proceedings of the Congress was also performed. All efforts have been made to review articles and abstracts related to internal and external validity.

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