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Effect of *Melia azedarach* L. intercropping on *Sorghum bicolor* (L.) Moench varieties in hills of Mizoram

Vikrant Malik, Rakesh Mohan* and Munesh Kumar†
Department of Forestry, Mizoram Central University, Aizawl-790009
*Department of Rural Development and Agricultural Production, NEHU Campus (Tura)
(†Present address: Department of Forestry, HNB Garhwal University, Srinagar Garhwal. Uttarakhand, India)

The field experiment was carried out in Mizoram University experimental farm by growing *Sorghum bicolor* varieties (CSV-15, RKV-400 and SPV-669) as sole crop (control) and *Sorghum bicolor* varieties with *Melia azedarach* (intercropped). The results observed that the height of all sorghum varieties reduced significantly when intercropped with *Melia azedarach*. Similarly, these varieties were also showed reduced length of bunch over control ($p<0.05$). The highest number of seeds per plant in intercropped was produced by the variety of CSV-15 (715.77±2.39) and the lowest by SPV-669 (345.55±2.42). The yield of all varieties was also significantly ($p<0.05$) decreased when intercropped with Melia azedarach compared to control. In intercropped the highest yield was of variety CSV-15 (22.85 kg per plot) followed by RKV-400 (18.45 kg per plot) and SPV-669 (18.02 kg per plot). However, similar reducing trend of *Sorghum bicolor* was also reported in control. Thus, it could be concluded that the growth performance of *Sorghum bicolor* varieties was good under control conditions. However, intercropping may provide some insurance against crop failure in high erosive areas. Therefore, intercropping could be helpful to minimize the effect of erosion, enhance sustainable productivity of sorghum by provide soil security as soil binder and tree can be used for some other alternative purposes.

Key words: *Sorghum bicolor*, *Melia azedarach*, intercropping, verities, yield

INTRODUCTION

Sorghum (*Sorghum bicolor* L.) is the fifth most important cereal grain crop in the world and reportedly feeds over 500 million people on a daily basis in the developing world providing dietary starch, dietary protein and some vitamins and minerals. Traditionally, sorghum grain is used for thin and thick porridges, noodles, tortillas, flatbread, biscuits, snacks, couscous, and traditional beer. Sorghum is mainly grown in the Semi-Arid tropic of the world, particularly under rain fed conditions. Although the production is highly influenced with changing environmental conditions (Showemimo 2007).

Melia azedarach is indigenous to north-west India along the sub-Himalayan tract, but now is naturalized throughout the tropics where it is cultivated in the arid and semi-arid and also in the semi-moist areas (Luna 2005). It is also found in Iran, Pakistan, Burma, Malayasia, Philippines, the Hawaiian Islands, Cuba and China (Anon 1981). It is a moderate-sized deciduous tree with a straight cylindrical bole. The bark is dark grey and flowers are lilac or pink colored. Medicinally the tree is used for leprosy, anthelmintic, diuretic, rheumatism and seed oil as antiseptic for sores and ulcers, skin diseases and malaria fever (Ramya et al. 2009).

Poor soil fertility and low moisture content are the major factors limiting crop production in arid and semi-arid region. In agroforestry system, silvipastoral system appears to be the most appropriate technology for cultivated soils, as one of the alternate land use to options in these areas (Kaushik and Kumar 2003). In this system forage and firewood yield from the alley components serves as an insurance against total crops failure due to aberrant weather and other conditions. The increased productivity under the tree canopy was believed to be due to improved soil fertility (Young 1989) and ameliorative influences of shade in a hot dry environment reducing temperature and evaporation (Bunderson et al. 1990). Thus, in dry area like Indian arid region, introduced trees can reduce the soil and plant water loss by reducing the under storey temperature and evapotranspiration (Belsky and Amundson 1992). Agroforestry systems have number of beneficial effect for constitute sustainable land use pattern and some of these are evidence in the world (Nair 1987, Young 1989). Many countries through agroforestry practices minimize the land degradation as well as increased the production also (Mishra and Sarim 1987, Swaminathan 1987).

Land degradation problems in hill are common i.e., water erosion, soil fertility depletion, flood etc. The hilly soils are the most susceptible to water erosion. About 75% of the hilly areas have very high susceptibility to erosion, 20% have high susceptibility and 5% have moderate susceptibility to erosion (BARC 1999). Faulty 'Jhum' cultivation in hilly area causes gully erosion and losses of soil ranges from 10 to 120 tons per ha per yr. (Farid et al. 1992).

*Correspondence to:
Telefax: +911370267529
E-mail: muneshmzu@yahoo.com

Decline of soil fertility occurs through and combination of lowering of soil organic matter and loss of nutrients. Removal of nutrients is also a threat to the agriculture. The negative soil nutrient balance have found in the country and the net removal of major nutrients (N, P, K, S) are as high as ranges between 180 and 250 kg/ha/yr (Karim et al. 1994). Trees can add a substantial amount of nutrients into the soil (Singh and Hazra 1995).

In Mizoram, shifting cultivation (Jhum) is the main mode of livelihood of the people, which was most acceptable; self sustained and environmentally sound in past years, because of limited populations, vast land areas, with minimum needs, never forced people to search alternate practices. With due course of time population explosion reduced jhum cycle which does not allow to recover of soil fertility and results in, insufficient production of food grains in subsequent years. Repeated cropping in the absence of tree on these steep hill slopes have declined both soil fertility and crop productivity due to accelerated soil erosion. Moreover, fire in shifting cultivation increases soil temperature and destroy the beneficial microorganism. These shifting cultivation areas in the absences of tree vegetation are being degraded, unsuitable for agricultural practices, low infiltration rated and high runoff, lead heavy soil erosion and loss of nutrients regularly, which due course of time unfit for agricultural productivity and people shift to another place for agriculture.

To avoid and minimize the ill devastating effect of shifting cultivation, in recent years intercropping system is recognized as the best technique stabilizing and improving sustainable farmland productivity, because continuous impact of degradation on natural forests, excessive soil erosion, loss of biological diversity, climate change as well as loss of socio-economic contributions of forests for human benefits can be minimize by suitable intercropping system. Therefore, the present study was undertaken to understand the effect of *Melia azedarach* intercropped on yield of *Sorghum bicolor* varieties and its impact on nutrient status of soil.

MATERIAL AND METHODS

The present study was conducted during the years 2003-2004 at Mizoram University, experimental farm, which is located between 92° 15' to 93° 29'E and 21° 58' to 24° 35'N at an elevation 432 m above sea level, 15 km far in west direction of Aizawl. The area receives annual rainfall between 2000 mm to 2400 mm; however, summer temperature ranges from 32°C to 34°C and winter 7°C to 12°C.

The experiment was carried out under the newly established plantation (2 years) of *Melia azedarach*, planted at the distance of 2 x 2 m, and under control conditions, Sorghum as sole crop or without plantation. Three different varieties of Sorghum bicolor were grown in both the conditions, i.e., under *M. azedarach* plantation and control. The total area of experiment was 40 x 40 m size, within this area 2 x 2 m size of bed was used further for each variety based on complete randomized block design. Thus, for three sorghum varieties (CSV-15; RKV-400 and SPV-669) 18 beds including 9 control beds 6 treatments and each has 3 replicates were used.

The soil samples were collected from three different depths of soil i.e., 0-10cm, 10-20cm and 20-30cm for analysis of soil nutrients. The available phosphorus (P) was determined using phosphomolybednum blue colorimetric methods (Jackson 1958) and exchangeable potassium (K) was determined by flame photometer after leaching the soil with I.P. ammonium acetate solution (Jackson 1958). The total available percent nitrogen (N) was determined by colorimetric technique (Jackson 1958). To know the amount of soil content used for the production of sorghum, as sole crop (control) and sorghum intercropped varieties, the soil analysis was done twice i.e., before sowing and after harvesting of sorghum.

RESULTS AND DISCUSSION

The NPK contents of the soil were decreased with crop maturity. However, the crop maturity enhanced moisture content in the soil. The reduction of NPK nutrients at the crop maturity might be due to utilization of these nutrients for the production of sorghum verities and enhance moisture content due to shade effect of crops which reduced moisture loss by evaporation. Among the nutrients (N, P and K) were higher in the soil before crop was grown and reduced with the crop production. Bandhyopadhya and De (1986) used N_{15} data to show that sorghum derives a part of nitrogen form a soil pool enriched by concurrently growth of legume. However, native soil–N levels and the amount of sunlight reaching legume species affect N_2 fixation (Anders et al. 1996). The response of *S. bicolor* is well to fertilizers especially N helps improve the total productivity of a cropping system (Mahakulkar et al. 1998, Ramesh et al. 2003). Nitrogen is one of the factors, which influences the production potential of a crop or cropping system (Ramesh et al. 2003). Application of nitrogen found special significance especially in intercropping system involving cereal + legume combination (Yadav et al. 1998). Similar studies on intercropping also carried out by several other workers (Roa and Rana 1980, Roa and Willey 1980, Lomte and Dhbhade 1990, Mutanal et al. 2001; Ramesh et al. 2003). Mutanal et al. (2001) also reported the compatibility of sorghum and teak intercropped and concluded that production of sorghum was higher as a sole crop compared with teak intercropped. Similarly, Sharma et al. (1996) also reported low yield of sorghum from adjoin rows of Eucalyptus.

All the collected data of plant height, number of leaves, area of leaves, length of bunch, weight of bunch, number of seed per plant and yield production kg per plot was taken at the time of harvesting at 3 months after sowing of sorghum varieties, when crop was mature. The height of Sorghum varieties intercropped with *M. azedarach* was 192.26±0.75 cm for the variety CSV-15 followed by 172.68±2.79 cm (RKV-400) and 151.51±1.75 cm (SPV-669). These values were decreased significantly ($p<0.05$) over control as 215.32±2.69 cm, 179.48±2.39 cm and 162.96±1.54 cm for CSV-15, RKV-400 and SPV-669 varieties respectively. Similarly, the area of leaves and numbers were recorded higher for all the varieties in control compared with intercropped varieties (Table 1). It was

Table 1. Effect of intercropping on growth performance of sorghum varieties (±SE)

Varieties/Control	Plant height	Number of leaves/ plant	Area of leaves/ plant	Length of bunch/ plant	Weight of bunch (g)	Number of seed/ plant
CSV-15	192.26±0.75	10.83±0.56	304.50±3.19	28.70±1.24	19.30±1.55	715.77±2.39
Control	215.32±2.69	11.61±0.56	342.06±1.51	34.59±1.57	23.88±0.61	844.10±22.00
RKV-400	172.68±2.49	8.99±0.57	217.96±2.52	24.13±1.54	15.06±0.55	526.22±5.63
Control	179.48±2.39	9.77±0.18	238.46±1.80	29.20±1.10	18.46±0.52	614.88±3.04
SPV-669	151.51±1.75	9.55±0.30	156.60±1.08	21.20±1.02	12.20±0.51	345.55±2.42
Control	162.96±1.54	9.44±0.15	185.06±1.75	25.42±1.00	16.62±0.64	408.66±2.69
SE±	2.50	0.26	23.39	1.42	0.62	6.89
CD at 5%	5.58	0.59	52.11	3.18	1.38	15.37

observed that in initial stage the all varieties have produced almost the same number of leaves and their area, which could be due to the initial growth of the plants coupled with prevailing climatic conditions. But variations at the time of maturity among the variety might be due to their genetical characteristics and competition for various other requirements as well as the phytotoxic effect of intercropped species. The competitive effect between *M. azedarach* and intercropped varieties basically depends on the crop maturity periods, rooting pattern, canopy spread etc. It is a proven fact that the use of natural resources viz., space, light, soil moisture, air etc. are more efficient with intercropping than under sole cropping (Lomte and Dabhade 1990). Similarly, the bunch length of sorghum varieties were taken at the stage when they have well developed grains bearing at their milking stage. All varieties reduced bunch length significantly ($p<0.05$) over control. The bunch length in intercropped with *M. azedarach* was ranged from 21.20±1.02 cm to 28.70±1.24 cm for SPV-669 and CSV-15 respectively (Table 1). However, the weight of bunch also observed and compared with control and found the values were also decreased (Table 1). The minimum and maximum values were 12.20±0.51 g (SPV-669) and 19.30±1.55 g (CSV-15) respectively. The highest (715.77±2.39) numbers of seed were produced by the varieties CSV-15 and lowest 345.55±2.42 by SPV-669 but the ranged values of control were higher compared to intercropped varieties (Table 1). A study carried out by Langat et al. (2006), said a performance of sorghum in both intercrop and sole crop in respect to yield and its components was significantly affected.

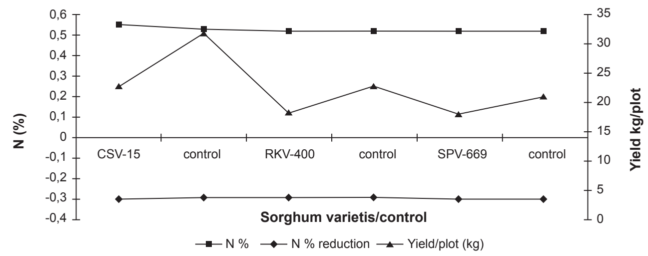

Figure 1. Nitrogen and its reduction for the yield production of sorghum varieties

The yield of different varieties correlate with nitrogen content is plotted in Fig. 1, which indicated that the yield production of all varieties were significantly ($p<0.05$) reduced in intercropped with *M. azedarach* compared to control. Moreover, the phosphorus and potassium kg per ha soil contents as observed before sowing and reduced after crop harvest is shown in Fig. 2. The maximum (22.85 kg/plot) yield was produced by CSV-15 *S. bicolor* variety was intercropped with *M. azedarach* followed by RKV-400 (18.45 kg/plot) and SPV-669 (18.02 kg/plot). These values were lower than the control values as 31.9, 22.98 and 21.07 g for CSV-15, RKV-400 and SPV-669 respectively.

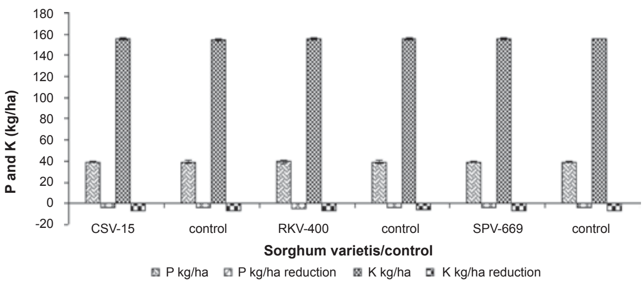

Figure 2. Phosphours and potassium reduction for the yield production of Sorghum varieties

Figure 3.

Figure 4.

Figure 3. Growth performance of sorghum varieties; (1-CSV-15; 2-RKV-400 and 3-SPV-669) in intercropped

Figure 4. Growth performance of sorghum varieties; (1-CSV-15; 2-RKV-400 and 3-SPV-669) in control

CONCLUSION

The growth performance of sorghum was good under control condition than intercropped. All parameter studied were recorded comparatively higher under control condition. However it reduced in intercropped, which might be due to competition for nutrients, light, space, etc. The study revealed that production of sorghum varieties was affected with intercropped, therefore, sole crop produced maximum production but the hilly terrain of Mizoram is highly risky to grow sorghum as sole crop. Therefore, intercropping could be helpful to minimize the effect of erosion and help to enhance sustainable productivity of sorghum by provide soil security as soil binder as well as tree can be used as some other alternative purposes, i.e., fuel, fodder, timber and ethnomedicinal uses. Although further studies on effect of intercrop on soil erosion and phytotoxic effect of trees on sorghum need to be conducted to the most successful acceptance of the tree in intercropping.

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