Effects of Mungbean *(Vigna radiata* (L.) R. Wilczek)on growth and yield of Subsequent Crops

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Abstract

A field experiment was conducted at the Kasetsart University LopBuri Campus Development Project, Tambon Phanied, Amphoe Kok Samrong, Changwat LopBuri to evaluate the potential allelopathic effects of different mungbean varieties (CN36, CN72, KPS1 and KPS2) on growth and yield of the subsequent crops (corn, sorghum and sunflower) during the period from March to November 2007. The identical experiment was repeated beginning from March-November 2008 in a different adjacent field. Four mungbean varieties and three subsequent crops were arranged in split-plot design with four replications. The 4 varieties of mungbean were assigned in main-plots and 3 subsequent crops were assigned in sub-plot. The results showed that mungbean promoted growth and yield of corn, sorghum and sunflower. The pronounced yield increases of the succeeding crops were observed in both years (2007 and 2008) when they were planted after mungbean KPS 2. Yields of corn, sorghum and sunflower planted after KPS2 in 2007 were 2,524, 2,833 and 2,731 kg/rai, respectively, which were 368, 468 and 246 percent as compared with control treatments. For 2008, yields of corn, sorghum and sunflower were 1,849, 2,118 and 2,051 kg/rai, respectively, which were 335, 390 and 135 percent as compared with control treatments. The increases in all yield components of the succeeding crops attributed to the increase in their grain yields in both years.

Keywords: corn, sorghum, sunflower, yield, subsequent crops, 1000-seed weight

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INTRODUCTION

Mungbean [*Vigna radiata* (L.) Wilczek] is a short duration legume and is grown under marginal condition of moisture stress and low soil fertility. It has a distinct advantage over other long duration summer legumes for utilization in various rotations and intercropping systems. Mungbean accumulates large amount of vegetation in a short period of time, so it could be used as a manure or as a cash cum soil improvement crop, by incorporating its residues into the soil after pods have been harvested at maturity. Like other leguminous crops, mungbean fixes atmospheric nitrogen through its symbiotic relationship with *Rhizobium* and *Bradyrhizobium* (Wisal *et al.,* 2010). The use of crop residues as a source of plant nutrients is increasing in many parts of the world where inorganic fertilizers have not proved to be economically/environmentally viable. At a time when there is increasing concern about the decline in organic matter (OM) content of soils, the use of crop residues may play an important role as a source of nutrients, OM and as mulching materials. In such system, plant residue incorporation into soil provides a better physical condition for plant growth (Dalal & Chan, 2001; Dalal *et al*., 1998). Muhammad *et al.,* (2010) reported mungbean crop, grown without mineral N fertilizer, produced 1166 kg ha−1 of grain in addition to 4461 kg ha−1 of the manure biomass (containing 52 kg N ha−1) that was ploughed under before planting rice with urea-N applied in the range of 0–160 kg N ha−1. Averaged across urea-N treatments, manuring significantly increased the number of tillers plant−1 (11% increase), rice grain yield (6% increase), grain N content (4% increase) and grain N uptake (9% increase). Significant residual effects of manuring were observed on the subsequent wheat crop showing higher grain yield (21% increases), grain N uptake (29% increase) and straw yield (15% increase). The results suggested the feasibility of including mungbean in the pre-rice niche to improve the productivity of the annual rice-wheat double cropping system. Cultivation of legumes for seed, fodder or green manure helps in sustaining the productivity of cereal based cropping systems and improves soil fertility through nutrient cycling (Herridge *et al*. 1995; Shah *et al*. 2003; Baijukya *et al*. 2005). Adil *et al.,* (2010) assessed wheat yield potential after mungbean. The results showed the significant increase in wheat plant height, spike length, number of grainsspike−1, 1000-seed weight and yieldplot−1. The yield obtained was increased 26.90% when planted after mungbean. Based on these results, cereal-legume crop rotation is highly recommended.

OBJECTIVE

The present study was carried out to evaluate the growth and yield of corn, sorghum and sunflower planted after mungbean.

MATERIALS and METHODS

Four mungbean varieties (CN36, CN72, KPS1 and KPS2) were planted as previous crops in March 2007 and harvested in June 2007. Plot size was 19.5 x 10 m^2 with a total of 16 plots and each plot contained 14 rows. The distance between rows was 75 cm and 25 cm between plants. Fertilizer grade 15-15-15 at the rate 50 kgrai−1 was applied before planting and plots were irrigated by sprinkler. Weed management was done at 2 weeks after planting. The RCB was used with 4 replications and the experiment was started in May 5, 2007. After harvest, mungbean stubble and debris were incorporated into the soil and allowed one month for decomposition. In August 2007, the three subsequent crops; corn (KSX 4901), sorghum (DA 5) and sunflower (Pac 77) were planted randomly after mungbean almost exactly on the same, previous, mungbean plots. The split plot design in RCB was used with 4 replications. Plot size was 19.5x40 m^2 with 16 rows per plot. The distance between rows was 75 cm, between plant was 25 cm and irrigated by sprinkler. Weed management was done manually at 1 and 2 months after planting, no insects and diseases infestation during both years. The subsequent crops were harvested in November 2007. Identical experiment was repeated beginning from March-November 2008 in a different adjacent field. The experiment was conducted at the Research and Development Center for farmers, Tambon Phanied, Amphoe Kok Samrong, Changwat LopBuri.

RESULTS

The results revealed that corn, sorghum and sunflower planted following mungbean have high yield as compared with control (each crops planted without preceding crop). Yield of corn, sorghum and sunflower were the greatest when planted after KPS2 (2,524, 2,833 and 2,731 kgrai−1, respectively in 2007). In contrast, yields of the control treatments were 685, 647 and 1109 kgrai−1, respectively. For 2008, yields of corn, sorghum and sunflower were 1,849, 2,118 and 2,051 kgrai−1, respectively, whereas yields of control treatments were 552, 543 and 1,516 kgrai−1, respectively. The stimulatory allelopathic effects of mungbean, as the previous crop, on grain yield of the subsequent crops in the first and second years are presented in Table 1. The results of this 2-year experiment revealed that all mungbean varieties stimulated grain yield of all subsequent crops. In both years, KPS2 showed the strongest positive effects in yield stimulation much more than the other varieties followed by KPS1, CN72 and CN36. Yield stimulation was about two-fold for sunflower and four-fold for both corn and sorghum. Tables 2, 3 and 4 illustrate yield components of the subsequent crops in both 2007 and 2008. The results revealed that all parameters measured; when corn, sorghum and sunflower were planted after mungbean, were significantly greater than respective control treatments in both years.

Table 1 Grain yield of the subsequent crops; corn, sorghum and sunflower in the first and second year.

First crops	Grain yield (kg/rai) of the subsequent crops[1]					
	2007			2008		
	Corn	Sorghum	Sunflower	Corn	Sorghum	Sunflower
CN36	961 c	1432 b	1406 c	781 d	784 c	1832 b
CN72	1082 b	1879 b	1706 c	1083 c	840 c	1932 b
KPS1	1549 b	2608 a	1840 b	1592 b	1675 b	2030 a
KPS2	2524 a	2833 a	2731 a	1849 a	2118 a	2051 a
Control	685 c	647 c	1109 c	552 d	543 c	1516 c
CV (%)	17.2	19.1	18.7	14.0	15.0	18.0
LSD (.05)	358	457	434	329	371	450

Note: [1] In a column, means followed by the same letters are not significantly different at 0.05 probability level by LSD.

Table2 Numbers of kernel rows per ear, numbers of kernel per row and 1000-seed weight of corn, as the subsequent crops in 2007 and 2008.

First crops	2007			2008		
	Numbers of kernel rows per ear	Numbers of kernel per row	1000-seed weight (g)	Numbers of kernel rows per ear	Numbers of kernel per row	1000-seed weight (g)
CN36	13.38 b	21.40 c	145.2 b	13.3 b	22.4 b	152.5 c
CN72	13.88 b	23.63 b	153.4 b	13.9 b	24.8 b	159.6 c
KPS1	14.75 a	29.03 b	163.44 a	14.3 a	28.2 a	165.3 b
KPS2	15.08 a	32.00 a	181.41 a	14.8 a	30.4 a	170.7 a
Control	12.78 c	18.10 c	137.24 b	12.6 c	18.3 c	135.5 d
CV (%)	3.7	13.6	15.8	3.2	12.4	7.5
LSD (.05)	0.72	4.65	27.52	0.69	4.76	18.09

Note: [1] In a column, means followed by the same letters are not significantly different at 0.05 probability level by LSD.

Table 3. Weight of seed per head and 1000-seed weight of sorghum, as the subsequent crops in 2007 and 2008.

First crops	2007		2008	
	Weight of seed per head (g)	1000-seed weight (g)	Weight of seed per head (g)	1000-seed weight (g)
CN36	30.40 b	28.50 b	24.9 c	27.4 c
CN72	36.08 b	30.00 a	31.0 b	32.2 b
KPS1	41.20 a	31.25 a	39.3 a	40.0 a
KPS2	46.48 a	32.25 a	45.0 a	46.7 a
Control	20.35 c	25.25 b	14.8 d	21.7 d
CV (%)	13.7	5.2	16.4	5.3
LSD (.05)	39.56	10.72	7.87	2.16

Note: [1] In a column, means followed by the same letters are not significantly different at 0.05 probability level by LSD.

Table 4. Flower disk weight, total seed weight per flower and 1000-seed weight of sunflower, as the subsequent crops in 2007 and 2008.

First crops	2007			2008		
	Flower disk weight (g)	Total seed weight per flower (g)	1000-seed weight (g)	Flower disk weight (g)	Total seed weight per flower (g)	1000-seed weight (g)
CN36	58.99 b	40.55 b	3.85 c	63.8 b	44.1 c	4.2 b
CN72	69.20 b	42.09 b	4.48 b	75.3 b	48.2 b	4.7 b
KPS1	84.40 a	52.88 a	4.83 b	100.8 a	53.4 b	5.1 a
KPS2	92.59 a	67.19 a	5.40 a	111.1 a	64.3 a	5.5 a
Control	47.01 c	31.66 c	3.50 c	57.8 c	35.9 d	3.5 c
CV (%)	16.8	30.9	4.0	8.5	9.1	4.4
LSD (.05)	8.29	5.86	0.27	9.27	6.55	0.30

Note: [1] In a column, means followed by the same letters are not significantly different at 0.05 probability level by LSD.

DISCUSSION and CONCLUSION

Mungbean promote growth and yield of the subsequent crops. KPS2 variety has allelochemicals that promote growth and yield of corn, sorghum and sunflower more than CN36 CN 72 and KPS1. Khaliq *et al*., (2007) reported that mungbean-wheat-mungbean-wheat cropping system resulted in 113% of wheat grain yield following mungbean-wheat cropping system. It can be concluded that mungbean rotation increase the yield parameters. Muhammad *et al.,* (2010) reported a short-duration grain legume like mungbean can be successfully inserted during the pre-rice fallow period in the rice-wheat double cropping system. Sukumarn *et al.,* (2010) reported allelochemic compounds from mungbean were highly polar and best separated under acidic condition. HPLC chromatogram of allelochemic compounds from mungbean root and stem composed of one major peak that had a retention time identical to that of thioglycerol and other 4 different peaks where one peak had a retention time similar to that of aglycone.

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