

Original Research Paper**Impact Of Preceding Legumes And Nitrogen Fertilizer On Soil Fertility And Growth Attribute Of Maize****ABSTRACT**

An experiment on maize crop with preceding legumes and nitrogen levels were carried out in the Research Farm of Agronomy, the University of Agriculture, Peshawar during 2011-2012 using summer legumes-maize cropping pattern. The summer legumes were sown in the summer gap ~~and available after wheat harvest till maize sowing~~ for grain, fodder and green manure purposes. Mungbean for grain and cowpea for fodder purpose and Sesbania was for green manure purpose using fallow as control. After legumes experiment each plot was split into four sub plots to accommodate four levels of N (0, 90, 120 and 150 kg ha⁻¹) for maize. Data was recorded on emergence m⁻², plant height, grains ear⁻¹ and ear weight. Soil parameters after legumes experiment i.e. pH, total soluble salts (TSS), electrical conductivity (EC), and calcium carbonate (CaCO₃) were not significantly affected by preceding legumes. Soil pH was higher in case of fallow plots while lower in plots previously cultivated with mungbean. Similarly, higher soil TSS, EC and CaCO₃ were recorded in plots previously sown with mungbean while lower soil TSS, CaCO₃ and EC was noted in plots left fallow. All the parameters under investigation were significantly affected by nitrogen levels except emergence m⁻² of maize. The effect of legumes was significant for grain ear⁻¹ and ear weight. Taller plants were produced in plots where N was applied at the rate of 150 kg ha⁻¹ followed by N application of 120 kg ha⁻¹ while control plots resulted in short stature plants. Plots fertilized with high N (150 kg ha⁻¹) had significantly higher ear weight which was at par with N application at the rate of 120 kg ha⁻¹. Higher grains ear⁻¹ were found in ear collected from plots treated with N at the rate of 120 kg ha⁻¹ which was at par with plots fertilized with N at the rate of 150 kg ha⁻¹. Control plots resulted in fewer grains ear⁻¹.

Key words: Maize, legumes, soil fertility and nitrogen levels,

I. INTRODUCTION

Cereal based cropping systems are predominantly followed in Pakistan because of higher productivity and profitability, and for ensuring food security. Previously balanced fertilization with N, P and K was thought to be essential for achieving high levels of productivity. However, with the passage of time, there is a gradual decline in factor productivity and increasingly higher doses of nutrients are required to be applied to achieve the potential yields of these crops. This situation is associated with deteriorating fertility of the soils and consequent emergence of

multiple nutrient deficiencies including those of micronutrients. Organic matter is the life of soil, and the practices that support organic matter build-up also favor sustainable productivity (Katyal et al., 2001). Incorporation of plant residues is a useful means to sustain organic matter content and thereby enhance the biological activity, improve soil physical properties and increase nutrient availability. Organic manuring by way of direct application of conventional farmyard manure, mulching or green manuring has declined over the years due to various operational constraints. 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).

In most parts of Pakistan, there is a hot summer period of 70–80 days available after the harvest of wheat till maize sowing from last week of April to mid July which can be utilized by short duration legume crops for enhancing grain legumes production or fodder availability or green manuring. Green manuring with annual leguminous crops like *Sesbania* is a widely known practice and is found beneficial not only for realizing potential yields but also for N economy and improving soil fertility (Singh et al., 1991). Likewise, mungbean as well as cowpea have direct value in human diet and potential to add N to the cropping system, especially when their residues with nodules are incorporated into the soil (Glasener et al., 2002).

It is not only desirable but quite possible to reduce the reliance on synthetic N fertilizers and move towards greater use of legumes to supply N for crop production. In fact, legume-based systems are likely to be more sustainable than cereal-based or fertilizer based systems. There are few studies quantifying the relative contribution of legumes in summer gap towards N economy, productivity, profitability and soil fertility in cereal based cropping system. Hence, a comprehensive study was undertaken to study the immediate and residual effects of legumes on

60 increasing productivity, improving soil quality and getting sustainability in cereal based cropping
61 system.

62 II. MATERIALS AND METHODS

63 The experiments were conducted at The Agronomy Research farm, the University of
64 Agriculture Peshawar during 2011-2012. Summer legumes-maize cropping pattern was followed
65 for the experiments. The summer legumes were sown in the summer gap (land available after
66 wheat harvest till maize sowing) for grain, fodder and green manure purposes. Mungbean was
67 used for grain purpose and cowpea was used for fodder purpose. Likewise, Sesbania was purely
68 used for green manure purpose. A fallow was included in the experiment as control. The legumes
69 were mungbean (grain purpose), cowpea (fodder purpose), Sesbania (green manure) and fallow
70 land. After the harvest of uniformly grown wheat crop, summer legumes i.e. mungbean, cowpea
71 and Sesbania were sown in the first week of May following recommended agronomic practices.
72 The biomass of Sesbania was incorporated into the field with a disc harrow in early July.

73 After thorough land preparation, each plot of the previous legumes experiment was split
74 into four sub plots to accommodate four levels of N to maize crop. Maize was sown with four
75 levels of N fertilizer (0, 90, 120 and 150 kg ha⁻¹) in mid July. Nitrogen was applied to maize
76 through urea in two equal splits, half each at sowing and 30 days of growth. Similarly, the
77 recommended rate of P fertilizer was applied to maize at sowing. For legume's experiment
78 randomized complete block design with four replications was used. Plot size of 5 m x 16 m
79 was used. For maize experiment, the plot of the previous legume's experiment was split into four
80 plots to accommodate four levels of N to maize. In this way, the subplot size was 5 m x 4 m. The
81 data was recorded on emergence m⁻² by counting total number of plants emerged in one meter
82 row length at three randomly selected rows in each sub plot and then converted to emergence m⁻²

². Plant height of the plant was measured as the distance from base to the tip of the plant of five randomly selected plants in each sub-plot. Grains ear^{-1} of five randomly selected ears was counted and averaged.

For recording soil physio-chemical characteristics, three soil samples were taken from different position in each subplot at random and were mixed together for the determination of different physiochemical properties of soil including pH, EC, total soluble salts (TSS) and CaCO_3 content. Soil sampling was done after the harvest of legumes.

Statistical analysis

The data were analyzed according to analysis of variance technique appropriate for RCB design for legume experiment and RCB design with split plot arrangement for maize and wheat experiments using Genstat discovery software. The treatment means were compared at $P < 0.05$ level of probability using LSD test (Jan et al., 2009).

IV. RESULTS AND DISCUSSION

Soil parameters after legumes experiment

Soil pH, total soluble salts (TSS), electrical conductivity (EC) and CaCO_3 content were not significantly affected by preceding legumes (Table 1). However, soil pH was higher in case of fallow plots. Similarly, higher soil TSS and EC were recorded in plots previously sown with mungbean. CaCO_3 content was higher in plots previously sown with Sesbania.

Emergence m^{-2}

Statistical analysis of the data showed that nitrogen levels (N) and legumes (L) had non-significant effects on emergence m^{-2} . The N x L interaction was also not significant. However, emergence was higher in N treated plots as compared to control. Likewise, plots previously sown

105 with cowpea and mungbean or kept fallow resulted in higher emergence m^{-2} while emergence
106 was lower in plots previously sown with Sesbania (Table 2).

107 **Plant height (cm)**

108 Different nitrogen levels significantly affected plant height of maize while the effect of
109 legume cropping system remained not significant (Table 2). The N x L interaction was not
110 significant. Plant height constantly increased as nitrogen level increased from 0 to 150 kg ha^{-1}
111 smaller plants (206 cm) were reduced in plots where N was applied at the rate of 150 kg ha^{-1}
112 followed by N application of 120 kg ha^{-1} (202 cm), while control plots resulted in short stature
113 plants. This increase in plant height could be attributed to positive effect of N on vigorous
114 vegetative growth the results are in agreement with the finding of Khan et al., (2009) who
115 reported that maize growth increased with increasing nitrogen fertilizer.

116

117 **Ear weight (g)**

118 Ear weight of maize was significantly affected by nitrogen levels and legumes (Table 2).
119 The N x L interaction was not significant. Linear increase was observed in ear weight of maize
120 as N level increased. Plots fertilized with high N (150 kg ha^{-1}) had significantly higher ear
121 weight (75 g) which was at par with nitrogen application at the rate of 120 kg ha^{-1} as compared
122 to control plots (54 g). Our finding are in line with Lopez et al. (2007) reported that nitrogen
123 application have positive relation with yield of maize. Similarly, ear weight was higher in plots
124 previously sown with cowpea or mungbean. Increase in ear weight is due the pleasant effect of
125 preceding legumes which might increase the availability of essential nutrient for plant growth.
126 Similar results are also reported by Sharma et al., (2009) that Sesbania green manuring and
127 legumes in cropping system have favorable effect on maize yield and yield attributes.

128 **Grains ear⁻¹**

129 Data on grains ear⁻¹ is presented in Table 2. Statistical analysis of the data indicated that
 130 nitrogen levels significantly affected grain ear⁻¹ of maize while the effect of legumes was not
 131 significant. Similarly, N x L interaction remained not significant. Grains ear⁻¹ increased as N
 132 increased from 0 to 120 kg ha⁻¹. Higher grains ear⁻¹ were found in ears collected from plots
 133 treated with N at the rate of 120 kg ha⁻¹ which was at par with plots fertilized with N at the rate
 134 of 150 kg ha⁻¹. Control plots resulted in fewer grains ear⁻¹. All N amended plots resulted in
 135 higher grain ear⁻¹ over control. Timely availability of nutrient mainly N in N amended plots
 136 increase in dry matter accumulation and better crop growth that could positively change the
 137 physiological functions of the maize crop (Ali et al., 1999)

138

139 Table1. Soil pH, TSS, EC and CaCO₃ as affected by preceding legumes.

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Legumes	pH	TSS (%)	EC (dsm ⁻¹)	CaCO ₃ (ppm)
Cowpea	8.200	0.060	0.187	12.833
Mungbean	8.167	0.066	0.207	12.917
Sesbania	8.167	0.059	0.183	13.250
Fallow	8.233	0.053	0.167	12.000
LSD(0.05)	ns	ns	ns	ns

141 Means of the same category followed by different letters are significantly different from one
 142 another at 5% level of probability.

143 ns = non-significant

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145

146 Table Emergence m⁻², plant height (cm), ear weight (g) and grains ear⁻¹ of maize as affected
 147 by different nitrogen levels and preceding legumes

	Emergence m ⁻²	Plant height (cm)	Ear weight (g)	Grains ear ⁻¹
Legumes				
Cowpea	11	205	77a	259 a
Mungbean	11	201	74a	263 a
Sesbania	10	191	63b	242 b
Fallow	11	193	60b	244 b
LSD (0.05)	ns	ns	9.23	13.54

	Nitrogen (kg ha ⁻¹)				
	0	10	188 d	54c	234 c
	90	11	195 c	64b	252 b
	120	11	202 b	77a	264 a
	150	11	206 a	79a	257 ab
LSD (0.05)	ns		3.54	4.12	14.68

Means of the same category followed by different letter(s) are significantly different from one another at 5% level of probability.

ns = non-significant

Conclusions and recommendation

It is concluded from the above results that summer legumes increase the availability of soil nutrient reduce nutrient losses, reduce fertilizer cost and thus have to improve the yield of maize crop on sustainable basses.



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