Abstract

Common bean (*Phaseolus vulgaris L.*) is an important grain legume in attaining food security and income. Amongst the common beans are the climbing beans that have indeterminate growth habit and require staking for support. Despite the importance of climbing bean in alleviating food insecurity, its production per unit area in Kenya has declined over the years. The decline is attributed to insufficient knowledge by farmers on the growth habit of climbing beans that is influenced by endogenous auxin activity, staking and mineral nutrient management. The study aimed to determine the effect of integrating naphthalene acetic acid (NAA), staking and mineral nutrient application on growth, yield, nutrient use efficiency and seed quality of climbing beans. The experiment was carried out in split – split plot experiment and laid down in Randomised Complete Block Design and replicated three times. This was done in three growing seasons at Kaguru Agricultural Training Centre. The treatments included three levels of NAA concentrations (0 ppm, 200 ppm and 400 ppm) which were randomly assigned to the main plot. The NAA was applied twice during the growth period through spraying at two weeks after crop emergence and at the onset of flowering for each concentration. Three levels of staking (no staking, staking with stakes and use of maize plants as support) were randomly assigned to the subplot. Four levels of DAP (18-46-0) fertiliser; 0, 200, 250 and 300 kg DAP per ha (equivalent to 0, 0; 36, 92; 45, 115 and 58 kg N per ha; 138 kg P per ha) were assigned to the sub-sub plot. Soil sampling and analysis were done before planting in order to determine the soil nutrient status in the study site. The Data was collected on growth and yield traits (Germination percentage, Number of leaves, Leaf chlorophyll content, Plant height, Root length, Total biomass, Number of branches, Days to physiological maturity, Yield per plant, Weight of one hundred seeds, Plant tissue N and P nutrient content, and Seed tissue N and P nutrient content growth vigour of the resultant plants). Data on growth and yield was used to determine Nutrient Use Efficiency, Harvest Index and Net Economic Benefit. The Data collected was subjected to ANOVA using statistical analysis software (SAS) version 9.3. The means that were significantly different were separated using LSD at a 5% level of significance. The integration of different levels of Naphthalene Acetic Acid, staking and mineral nutrient N and P affected the various parameters in climbing bean production. The germination % ranged from 52.78 % for 300 kg DAP per ha to 96.89 % for 0 kg DAP per ha, the number of leaves from 19.22 leaves for A3S3F1 (400 ppm NAA, maize plants as support and 0 kg DAP per ha) to 74.20 leaves for A3S2F4 (400 ppm NAA, staking by use of stakes and 300 kg DAP per ha), the plant height from 176.33 cm high for A3S1F1 (400 ppm NAA, unstaked climbing bean plants and 0 kg DAP per ha) to 388.89 cm for A3S2F4, the number of branches from 2.89 branches for A1S3F1 (0 ppm NAA, maize plants as support and 0 kg DAP per ha) to7.89 branches A1S1F4 (0 ppm NAA, unstaked climbing bean plants and 0 kg DAP per ha), the number of days to physiological maturity from 78.67 days for A1S1F1 (0 ppm NAA, unstaked climbing bean plants and 0 kg DAP per ha) to 92 for A1S2F3 (0 ppm NAA, staking by use of stakes and 250 kg DAP per ha), the root length from viii

12.89 cm for A3S3F1to 30.00 cm for A3S2F3 (400 ppm NAA, staking by use of stakes and 250 kg DAP per ha), the chlorophyll content of leaves from 37.67 spads for A1S3F2 (0 ppm NAA, maize plants as support and 200 kg DAP per ha) to 62.53 spads for A1S2F4 (0 ppm NAA, staking by use of stakes and 300 kg DAP per ha), the number of pods per plant from 15.00 pods for A1S3F1to 44.33 pods for A2S2F4 (200 ppm NAA, staking by use of stakes and 300 kg DAP per ha), the number of seeds per pod from 4.00 seeds for A2S1F1 (200 pmm NAA, unstaked climbing bean plants and 0 kg DAP per ha) to 7.33 seeds for A2S2F4, the yield per plant from 6.50 g for A1S3F1 to 52.70 g for A2S2F3 (200 ppm NAA, staking by use of stakes and 250 kg DAP per ha), the weight of 100 seeds from 57.21 g for A3S2F4 to 75.37 g for A1S3F1, the total yield from 630.77 kg per ha ha -1 for A1S3F1to 3137.09 kg per ha for A2S2F3 (200 ppm NAA, staking by use of stakes and 250 kg DAP per ha), the seed P content from 0.1567 % for A1S1F1 to 0.6240 % for A3S2F4, the seed N content from 2.0733 % for A1S1F1 to 4.8867 % N for A3S3F4 (400 ppm NAA, maize plants as support and 300 kg DAP per ha), the crude protein of the seed ranged from 12.96 % for AISIF1 to 30.54 % for A3S3F4, the plant tissue P and N ranged from 0.158 % P and 2.692 % N for A1S1F1 to 0.3990 % P and 3.2732 % N for A3S2F4, the total biomass from 35.73 g for A2S3F1 (200 pmm NAA, maize plants for support and 0 kg DAP per ha) to 127.70 g for A2S2F4, the harvest index from 8.98 % for A1S3F1 to 20.20 % for A2S2F4, the nitrogen use efficiency ranged from 19.80 kg per kg for A1S3F4 (0 ppm NAA, maize plants for support and 300 kg DAP per ha) to 66.99 kg per kg for A2S2F3, the phosphorus use efficiency ranged from 8.32 kg per kg for A1S3F4 to 25.65 kg per kg for A2S2F3, the plant height for the resultant plants ranged from 148.331 cm for A3S2F2 (400 ppm NAA concentration, staking by use of stakes and 200 kg DAP per ha) to 186.20 cm for A2S3F4 (200ppm NAA concentration, bean plants supported by maize plants and 300 kg DAP per ha), the number of leaves for the resultant plants ranged from 25 leaves for A2S1F1 to 35 leaves for A3S3F1, the number of branches for the resultant plants ranged from 3 branches for A3S1F1 to 4 branches for A1S2F3, the net economic benefit ranged from Ksh. 28,520 for A1S2F1 (0 ppm NAA, staking by use of stakes and 0 kg DAP per ha) to Ksh. 198,009 for A2S2F3. Generally, the performance of integrating 200 ppm, staking by use of stakes and 300 kg DAP per ha significantly increased many growths and yield related parameters while integrating 400 ppm NAA, staking by use of stakes and 300 kg DAP per ha increased a number of growth parameters but not mainly the yield and yield related parameters. For high nutrient use efficiency and of net economic benefit of climbing beans the farmers would be recommended to use 200 ppm NAA, staking by use of stakes and 250 kg DAP per ha.