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Evaluating the Effects of Compound L ($N_7P_{13}K_{20}$) as a Basal Fertiliser for Cotton Production in Zimbabwe

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Abstract

A study was conducted in Chivende district, Mashonaland west province to evaluate the effects of basal fertiliser rates on plant productivity. A randomised complete block design (RCBD) was used to conduct the experiment. The experiment consisted of three treatments replicated three times which were 50kg ha^{-1}, 100kg ha^{-1} and 150kg ha^{-1}. The parameters that were measured included cotton growth (height), cotton quality and the subsequent yield. The data was analysed using Genstat 14th edition. Means were separated using Fisher's Protected LSD at 5% level. The results of the study showed that the highest compound L rate of 150kg ha^{-1} resulted in good quality lint of medium staple length (28.22mm) and the highest unstained fibre (99.62%). The treatment (150kg ha^{-1}) also had tall plants (126.80cm) and high yields of seed cotton 1781 kg ha^{-1}. This demonstrates that compound L fertiliser is necessary for cotton production particularly at the 150kg ha^{-1} rate. It is therefore recommended that smallholder farmers should use compound L at 150kg ha^{-1} for maximum cotton yield and the best cotton quality.

Keywords: compound L; basal fertiliser; cotton production.

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1. Introduction and background

Cotton (*Gossypium hirsutum*) is a major cash crop that is produced worldwide for its lint and seed. The seed has high level of protein and fat [13]. It is also produced by many countries in Africa among them Zimbabwe. In the Southern African region it is mainly produced by small scale farmers who are located mainly in the marginal areas. In Zimbabwe cotton is a strategic crop for poverty alleviation and is of major significance to food security of the majority of smallholder farmers in marginal areas due to its contribution to incomes as well as employment creation. The crop is a major source of livelihood for over a million people in Zimbabwe because of it being a major source of raw materials for the oil expressing industry with more than half of the cooking oil made in Zimbabwe coming from cotton seed [6]. In Zimbabwe, it is the second largest agricultural foreign currency earner after the golden leaf (tobacco), contributing about 19% of agricultural export earnings [6].

Cotton is now under the spotlight among other crops due to fluctuation in its producer price and this has made it difficult for those farmers who rely on the crop as their only source of income [11]. In Zimbabwe, being among southern and eastern Africa's largest cotton producers competing with Tanzania and was until recently the regional standard bearer for quality [3]. During the 1990s the sector made a smooth transition from a production system based on large scale commercial farms to smallholder farming. A seasonal loans scheme run by Cottco, the parastatal and largest player in the sector, was at the heart of the transition, allowing smallholder producer to achieve yield that were impressive by southern and eastern standards. The sector maintained its historic reputation for high quality lint.

Cotton can resist some conditions which are difficult for other crops in Africa and it is grown in marginal areas. The cotton growers are not enjoying profits because of poor yields and poor quality due to several factors such as poor rainfall, low input supply, lack of access to new technology and poor agronomic practices such as fertiliser management [6]. An average yield of 700kg ha^{-1} is realised in Zimbabwe and stakeholders are making efforts together with researchers to improve yields and finding ways which can sustain cotton industry [11]. In other parts of the world, some countries have adopted the use of Biotechnology as a solution to this problem. They are using Genetically Modified (GM) cotton which can produce more yields ha^{-1} and can withstand pest and disease attack such as Bt cotton. In Southern Africa, countries such as Zimbabwe, Zambia and Uganda are still debating on adoption of such technology as the by-products are indicated to be unsafe for human consumption [6]. Fertilizer management in cotton is one of the most important factors in successful cultivation of crops affecting yield, quality and quantity [2]. Farmers in Hurungwe district have been growing cotton for many years but realizing low yields of about 600-700kg ha^{-1} [16]. In the resettlement area, farmers are growing the crop with low compound L fertiliser at 50kg ha^{-1}. Compound L is believed to offer an increase in yield and quality of cotton. Thus the purpose of the research was to compare the use of compound L difference rates on height, quality and yield of cotton in the district.

2. Materials and methods

The study was conducted in ward 14 of Hurungwe district in Mashonaland west situated 110 km south west of Karoi town. The ward falls into agro ecological region 3. The agro ecological region is characterised by semi-intensive mixed farming based on crop production although semi-intensive beef production is also done. Rainfall received is around 650-800mm and is less reliable and the area has light sands to loam sandy soils. The region has 14-16 wet pentads per season and may have fairly severe mid season dry spells. Farmers grow tolerant grain crop and other cash crops [16].

A randomised complete block design with three replicates and three treatments were used for the study. The experiment was divided into three blocks with each treatment replicated three times to give a total of 27 equal plots. One metre was left between each of the plots and between the whole experimental field and rest of the surroundings in order to eliminate border effects. The three treatments that were used were 50kg ha^{-1}, 100kg ha^{-1} and 150kg ha^{-1} of compound L fertiliser.

3. Field operations

Land preparation was done using an ox drawn plough set at a depth of 20cm to produce a fine tilth which is required for effective crop emergence. Harrowing was done using an ox drawn harrow to destroy big soil clods. The experimental blocks were divided into 27 equal blocks, each measuring 2×2m.

Cotton seed was planted at a rate of 15kg ha^{-1} for all the treatments on the same day in November. The fertiliser that was used for basal treatment was compound L. Each of the 27 treatments required seeds of 0.162kg ha^{-1}. Planting was done using hoes. Planting stations were first marked using row markers with a spacing of 0.9m between lines and 0.3m between each planting station. Each planting hole was 2cm deep. Three seeds were put per hole and some slight covering was done to maintain a shallow depth of 20mm since the cotton seed is a weak germinator [11].

Thinning of the crop was done on the second week after crop emergence by removing some plants in order to remain with 1 plant per planting station. During thinning, weaker cotton plants were removed leaving the healthier ones. Weed management was done when the crop was 4 weeks because of the low weed pressure. Weeding at this stage was done using hoes. The second phase of weeding was done at 7 WACE and the third and final round of weeding was done at 16 WACE to ensure cleanliness of the field during data collection. Insect pest management was done against aphids, *heliothis* and red boll worm at 4WACE. For aphids, one leaf from the middle of the plant, 2 top leaves and the growing point were selected and the number of aphids that were present on the plant parts were counted. Dimethoate 45% EC insecticide was sprayed at a rate of 500ml ha^{-1}. For bollworms, the whole plant was scouted starting at the bottom up to the growing points. The number of eggs and larvae were recorded. Carbaryl 85% WP for *Heliothis* and red bollworm was used at a rate of 2kg ha^{-1}. Picking of the cotton plant was done when the crop attained 20% boll split with a moisture content of 12.5% and when there was an average number of bolls ranging from 4 to 5.

4. Results

Effects of compound L on the height of cotton plants

There was a significant difference ($p<0.05$) on height between cotton plants treated with 50kg ha^{-1}, 100kg ha^{-1}

and 150kg ha^{-1}. The lowest application rate recorded the shortest cotton plants (77cm) followed by 100kg ha^{-1} (104.6cm) and lastly 150kg ha $^{-1}$ which were 126.8cm tall.

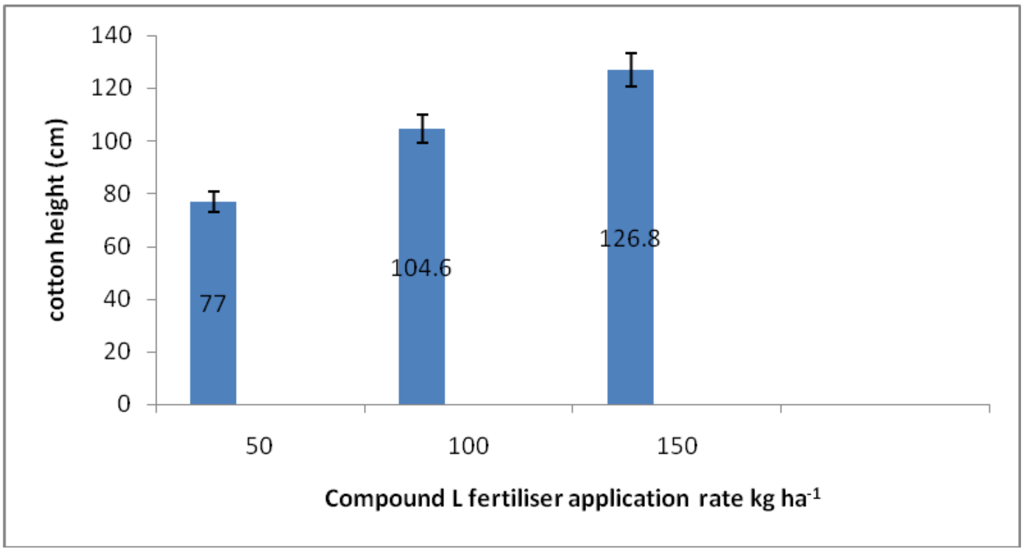

Figure 1

Effects of fertiliser application rates on quality

The effect of different application rates on quality of cotton was assessed in terms of the proportion of stained lint, clean lint and fibre length. The results show that there were significant differences among treatment means with regards to proportion of unstained lint. The application rate of 150kg ha^{-1} gave 99.62% clean lint. This was followed by 100kg ha^{-1} which gave 99.54% and lastly 50kg ha^{-1} which gave 99.39% of clean cotton lint. This therefore implies that the proportion of stained seed cotton decreased in the order of 150, 100 and lastly 50kg ha^{-1}.

Table 1: Effect of compound L on quality of cotton fibre

Treatment	Clean lint (%)	Stained lint (%)	Fibre length (mm)
50kg ha^{-1}	99.39a	0.61a	26.33a
100kg ha^{-1}	99.54b	0.46ab	27.22b
150kg ha^{-1}	99.62c	0.38b	28.22c
Mean	99.519	0.481	27.259
LSD $_{5\%}$	0.1592	0.1592	0.3314
SED	0.0768	0.0768	0.1563
P value	0.019	0.09	<0.001
CV 5%	0.2	33.8	1.2

NB Means followed by different letters are significantly different at P<0.05).

There was also a significant difference on fertiliser application rate on fibre length at (P< 0.001). The highest fibre length (28.22cm) was obtained when an application rate of 150kg ha^{-1} was used followed by 100kg ha^{-1}

which gave 27.22cm and lastly 50 kg ha^{-1} which had the smallest fibre length of 26.33cm.

Effects of basal fertiliser on fertiliser length and yield

The results shows that there were significant differences ($p<0.001$) among the treatments. The highest yield was obtained where 150kg ha^{-1} was applied to cotton crops which gave 1781kg ha^{-1}. The yield was followed by 100kg ha^{-1} treatment which gave yields of up to 1085 and lastly 50kg ha^{-1} which gave yields of 578kg ha^{-1}.

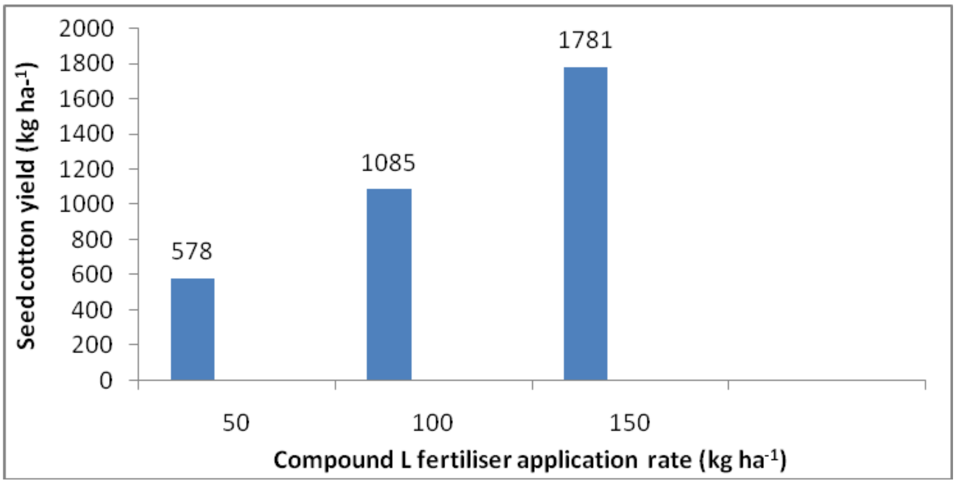

Figure 2

5. Discussion

The results of the study obtained on seed cotton yield showed that the highest yield was obtained from the experimental plots treated with 150kg ha^{-1} compound L. This is because high nitrogen promotes plant growth through fruiting and boll retention [18; 20]. The availability of NPK and water are major constraint in cotton production in most cotton producing environment. Nitrogen is generally considered a yield limiting factor both dry land and irrigated cotton production systems that focus on optimising lint yield and avoiding excessive application that reduce quality. Deficiency of nitrogen can reduce both vegetative and reproductive growth leading to yield loss [7]. The cotton yield is determined by the number of bolls produced per unit area and boll weight [20]. [8] reported that fruit shedding and boll retention were primarily related to nutrition. The cotton growth would be influenced by varieties of genetic characteristics, environmental conditions, cultural practices and other factors such as fertilisation [21]. Nitrogen promote cotton growth and development and make the relationship among the leaf buds bell system more coordinated for cotton yield [10].Yield advantages could have therefore because of optimal N application that resulted in larger bolls at a greater number of fruiting sites [5]. Increases in yield with increasing fertiliser application was also observed by [17; 4; 1] and [9]. They found that the treatments of potassium fertilizer applied in two forms (soil addition plus foliar spray) which is a characteristic of compound L fertiliser in the appropriate time lead to an increase in boll number and boll weight, and consequently an increase in cotton yield. Higher fertiliser applications also increased the yields of seed cotton in Egypt [2]. The addition of potassium increases tolerance to cotton diseases and produces higher quality lint [2]. In a related study in Egypt, all the three potassium rates (319, 638 and 957 kg ha^{-1}) significantly increased seed cotton yield per plant, seed cotton and lint yield per ha [19].

Cotton quality was measured in terms of stained lint, clean lint as well as fibre length. The results indicated that good lint quality was obtained in a treatment were 150kg ha-1 was applied. This was because of the improvement in the economics of production and efficiency of nutrient use. Pottasium which constitutes compound L fertiliser is an extremely important nutrient in cotton production which affects properties such as length and strength of the cotton lint [17].

6. Conclusion and Recommendations

From the findings of the study, it can be concluded that growing cotton using 150kg ha^{-1} of compound L fertiliser can increase the height of the cotton plant. Increases in fertiliser rates maximised the yield as well as the quality of the cotton lint through an increase in the length of the lint as well as its cleanliness while the treatments that were applied with lower fertiliser rates had lower yields and lower quality cotton lint. Both smallholder farmers as well as large scale farmers can apply compound L fertiliser at a rate of 150kg ha^{-1} to maximise cotton production.

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