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Effect of seed rate on upland cotton (*Gossypium hirsutum*) seedling emergence

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The most important factor to achieving profitable cotton yields is obtaining a uniform stand of healthy and vigorously growing seedlings. Cotton seedling emergence highly depends on the number of seeds that are planted on the same planting station. The cotton seedling stalk is weak and may fail to push up and crack the soil in order to emerge. Therefore several seedlings put together may use the power of numbers to push out of the soil. Cotton seedling emergence percentage and stand are closely related to seed rate. In Zimbabwe the question of which seed rate is optimal took centre stage in input negotiations between contractors and farmers. A research project was therefore conducted at Cotton Research Institute, Tokwane, Mahuwe, and Muzarabani communal areas during two seasons of 2014 to 2015 in order to determine the effect of seed rate on cotton seedling emergence. The experiment was laid in a randomized complete block design with eight treatments of varying seed rates that ranged from two to nine seeds per planting station and with four replications. Results showed significant differences on stand counts among seed rates. At C.R.I and Mzarabani communal area three seeds per station achieved better stand counts while at Tokwane, five seeds per station resulted in better stand counts. In Mahuwe communal area, six seeds per station performed better. However, six seeds per station was the median seed rate that produced the highest stand counts across sites and across seasons. It is therefore recommended that farmers can plant three up to six seeds per station depending on environmental conditions

Key words: Cotton, seed rate, seed, stand counts, emergence, seedling.

INTRODUCTION

Cotton germination begins as the seed absorbs water and oxygen through its seed coat after planting. The hypocotyl elongates from the radicle and forms an arch or crook that begins to push up through the soil, a brief period often referred to as the “crook stage” (Cotton Germination and Seedling Development, 2012). At this stage, the cotton seedling may fail to push out the soil on its own. Rapid seed germination and emergence is an

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important factor in crop successful establishment, (Somayeh et al., 2015). Achieving even establishment of a cotton crop is critical in getting the crop off to a good start, as it can influence how the crop is to be managed. The aim of every cotton grower should be to plant the crop once and achieve the desired plant stand and evenness and get the crop off to a great start. The emergence of cotton seedlings is influenced by several factors, these being mainly the seed, the environment, and various mechanical factors. The environment influences seedling emergence through biotic and abiotic factors, (Gitz et al., 2015). Biotic factors such as presence of soil pathogens, nematodes, bacteria, or fungi affect the survival of seedlings during or shortly after emergence. The effects of biotic factors on seedling emergence vary greatly from site to site. The environment provides the basic requirements of light, heat, oxygen and moisture as the abiotic factors affecting cotton seedling emergence. The mechanical factors provide such aspects of the planting configuration as row spacing, seed placement distance, depth of sowing, seed rate, and degree of seed-soil contact.

The seed is one of the most important inputs in cotton production, (Nazir et al., 2014).The use of delinted cotton seeds in cotton planting instead of fuzzy cotton seeds has spread recently, (Zeybek et al., 2010). Planting of cotton seed when soil temperature and conditions are favorable at the proper depth and seeding rate is very important to give the crop the best chance of emerging properly and getting off to a good start. About 3.33 kg of seed of the cotton variety SZ9314 would be sufficient for a hectare if one seed was planted per planting station. The cotton seedling stalk is weak and may fail to push up and crack the soil in order to emerge. Therefore several seedlings put together may use the power of numbers to push out of the soil. That is the reason why several cotton seeds are planted at the same position and at as shallow a depth as 20 mm. The general and traditional seed rate recommendation of 25 kg/hectare, (Cotton Agronomy Manual, 2012), was viewed as too luxurious by some key players of Zimbabwe's cotton industry with claims that 15 kg/hectare would suffice. This study therefore sought to determine the optimum seed quantity required per unit area for optimum seedling emergence under rain fed cotton production in different agro ecological conditions of the cotton growing regions in Zimbabwe.

MATERIALS AND METHODS

The experiment was carried out for two seasons, 2014 and 2015 at four sites namely Cotton Research Institute in Mashonaland West Province, Tokwane communal area in Masvingo Province, Mahuwe and Mzarabani communal areas in Mashonaland central Province (Table 1). Treatments consisted of eight different seed rates of the cotton variety SZ9314 which has an average cotton seed weight of is 0.1g. The treatments used are shown in Table 2. Six seeds per planting station was used as the standard treatment. The treatments were laid out in a Randomised Complete Block Design with four replications. The recommended plant spacing of 1m between rows and 30cm within rows was used. The gross plot was 6 rows of 8 metres length and the net plot was 4 rows of 6 metres length. Basal fertilizer application was applied using soil analysis results. Stand counts were recorded one week after crop emergence. Analysis of variance on data collected of stand counts was performed using GenStat 14th edition for Windows, (Payne et al., 2011). The differences among treatment means were compared by Fisher's Protected Least Significant Differences test (LSD) at 0.05 level of probability

RESULTS AND DISCUSSION

Stand counts

Results in Table 3 indicated significant interactions at 5% level on stand counts among seed rate, site, and season. Thus, the relationship between seed rate and stand counts varied from site to site and from season to season, hence the results of the interactions on the effects of seed rate on seedling counts are presented by site and by season. Table 3 indicates the combined performance of the treatments over the two seasons. C.R.I represents Cotton Research Institute. At C.R.I three and five up to nine seeds per station had comparably the highest stand counts while two seeds per station had the lowest stand counts. At Tokwane communal area, five, six, eighty and nine seeds per station produced the highest stand counts. Results also indicated that six up to nine seeds per station had comparably the highest stand counts at Mahuwe communal area and at Mzarabani, three up to nine seeds per station produced the better stand counts. C.R.I represents Cotton Research Institute.

In 2014 season, results indicated significant differences on stand counts at C.R.I, Tokwane and Mahuwe and no significant differences at Mzarabani. At C.R.I, two seeds per station gave the lowest stand counts while three to nine seeds per station had comparably the highest stand counts. At Tokwane communal area, two seeds per planting station gave the lowest stand counts, while 3, 4, 5, 6, 7 and 9 seeds were comparable. Eighty seeds per station gave the highest stand counts which was comparable to 4, 5, 6, and 9 seeds per station. At Mahuwe, two seeds per station had the lowest stand while four to nine seeds resulted in comparably the highest stand counts (Table 4).

In 2015 season, results showed significant differences on cotton stand counts at C.R.I, Dande and Mzarabani and no significant differences on stand counts at Tokwane. At C.R.I two seeds per station had the lowest stand counts which were comparable to 3, 4, 5, 7 and 8 seeds per station. Stand counts for three seeds per station were comparable to that of six and seven seeds per station (Table 5).

Nine seeds per station had the highest stand counts which were comparable to that of six and three seeds per station. At Mahuwe communal area, two seeds had the lowest stand counts. Three to five seeds per station had

Table 1. Characteristics of experimental locations.

Location	Longitude and latitude	Altitude (asl) (m)	Soil type	Average rainfall (mm)
C.R.I	18° 20′ S and 29° 54′ E	1156	red clay loamy soils	666
Mahuhwe	16° 23′ S and 30° 44′ E	455	upland loamy sandy soils	754
Mzarabani	15° 45′ S and 29° 19′ E	600	clayey alluvial soils	909
Tokwane	19° 49′ S and 30° 20′ E	547	clay loamy soils	521

asl represents above sea level.

Table 2. Description of treatments used in this project.

Treatments	Number of seeds per station	Seed rate per hectare (kg)
1	2	9
2	3	12
3	4	15
4	5	18
5	6	20
6	7	24
7	8	27
8	9	30

Table 3. Effect of cotton seed rate on stand counts across season.

Treatments	Sites			
Seeds/station	**C.R.I**	**Tokwane**	**Mahuwe**	**Mzarabani**
2	26 719^{a}	15 364^{a}	16 771^{a}	24 688^{a}
3	30 781^{bc}	21 823^{b}	23 177^{b}	27 969^{b}
4	30 312^{b}	21 771^{b}	24 844^{bc}	28 698^{b}
5	31 198^{bc}	22 031^{bc}	26 719^{cd}	30 104^{b}
6	31 667^{bc}	22 188^{bc}	28 438de	29 869^{b}
7	31 250^{bc}	21 667^{b}	28 594de	29 427^{b}
8	31 354^{bc}	24 010^{c}	29 474^{e}	29 167^{b}
9	32 292^{c}	22 552^{bc}	30 156^{e}	29 636^{b}
Grand mean	**30 697**	**21 426**	**26 022**	**28 698**
P	*<0.001*	*<0.001*	*<0.001*	*0.017*
L.S.D	1807.30	2177.7	2564.5	3005.3
CV (%)	5.8	10.1	9.8	10.4

Means followed by the same letter are not significantly different at p = 0.05 and means were separated by the Fishers' LSD. C.R.I represents Cotton Research Institute.

comparable stand counts while five to eighty seeds per planting station had comparable stand counts. Nine seeds per station gave the highest stand counts, comparable to six, seven and eighty seeds per station. At Mzarabani, two seeds per station had the lowest stand counts while the other seed rates resulted in comparably the highest stand counts.

Though the performance of the seed rates varied from season to season and site by site, however six seeds per station was the median seed rate across sites and across seasons that resulted in the highest cotton stand counts. The targeted stand count 0f 33 333 per hectare was not achieved at any site for the two seasons. The failure to achieve the targeted stand count could have been due these factors that influence the seed germination and seedling emergence apart from the seed rate. Wanjura (undated) has also noted these factors to be the reasons for causing poor emergence even if seeds were planted properly, as some of these factors are largely uncontrollable.

Table 4. Effect of cotton seed rate on stand counts per hectare in 2014 season**.**

Treatments	Sites			
Seeds/station	**C.R.I**	**Tokwane**	**Mahuwe**	**Mzarabani**
2	24271[a]	13958[a]	20729[a]	23646
3	31 146[b]	24 792[b]	27 396[b]	26250
4	30 417[b]	26 979[bc]	31 250[c]	27500
5	32 187[b]	26 771[bc]	30 729[c]	30104
6	31 458[b]	26 146[bc]	32 708[c]	28750
7	32 187[b]	26042[b]	32 083[c]	28854
8	32 604[b]	30000[c]	32 812[c]	27604
9	32 604[b]	28021[bc]	32 708[c]	28229
Grand mean	**30 859**	**25 339**	**30 052**	**27 617**
P	*<0.001*	*<0.001*	*<0.001*	*0.176*
L.S.D	3265.2	3885.2	3100.5	4499.8
CV (%)	7.2	10.4	7.0	11.10

Means followed by the same letter are not significantly different at p = 0.05 and means were separated by the Fishers' LSD. C.R.I represents Cotton Research Institute.

Table 5. Effect of cotton seed rate on stand counts per hectare in 2015 season.

Treatments	Sites			
Seeds/station	**C.R.I**	**Tokwane**	**Mahuwe**	**Mzarabani**
2	29167a	16771	12812a	25729a
3	30417abc	18854	18958b	29688b
4	30208a	16563	18438b	29896b
5	30208a	17292	22708bc	30104b
6	31875bc	18229	24167cd	31042b
7	30313ab	17292	25104cd	30000b
8	30104a	18021	26146cd	30729b
9	31979c	17083	27604d	31042b
Grand mean	**30534**	**17513**	**21992**	**29779**
P	0.030	0.089	<0.001	0.002
L.S.D	1641.1	1592.7	4333.4	2317.4
CV (%)	3.7	6.2	13.4	5.3

Means followed by the same letter are not significantly different at p = 0.05 and means were separated by the Fishers' LSD. C.R.I represents Cotton Research Institute.

Conclusions

At C.R.I and Mzarabani communal area three seeds per station achieved better stand counts while at Tokwane, five seeds per station resulted in better stand counts. In Mahuwe communal area, six seeds per station performed better. However, six seeds per station was the median seed rate that produced the highest stand counts across sites and across seasons.

Recommendation

It is therefore recommended that farmers can plant three up to six seeds per station depending on environmental conditions.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

REFERENCES

Cotton Agronomy Manual (2012). Cotton Research Institute, Crops Research Division, Department of Research and Specialist Services, Ministry of Agriculture ,Mechanization and Irrigation Development, Zimbabwe.

Gitz DC, Baker JT, Mahan JR (2015). Evaluation of a Metabolic Cotton Seedling Emergence Model. American Journal of Plant Sciences 6(11):1727-1733.

Nazir MS, Saad A, Anjum Y, Ahmad W (2014). Possibility of seed priming for good germination of cotton seed under salinity stress. Journal of Biology, Agriculture and Healthcare 4(8):66-68.

Payne RW, Harding SA, Murray DA, Soutar DM, Baird DB, Glaser AI, Welham SJ, Gilmour AR, Thompson R and Webster R (2011). GenStat® Release 14 Reference Manual. VSN International Ltd. Hemel Hempstead, Hertfordshire HPI IES, UK http://www.genstat.co.uk/

Somayeh R, Mohammad RRM, Amir BB (2015). Cotton Seed Germination as Affected by Salinity and priming. Indian Journal of Fundamental and Applied Life Science 5(1):312-318.

Wanjura DF (Undated). Field Environment and Stand Establishment. USDA-ARS. Lubbock, Texas at http://www.cotton.org/...books/cotton.../Cotton-Physiology_Chapter36.pdf

Zeybek A, Dogan T, Ozkan I (2010). The effects of seed coating treatment on yield and yield components in some cotton *(Gossypium hirsutum L.*) varieties. African Journal of Biotechnology 9(34):5523-5529.