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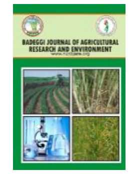

Research Article

Evaluation of Sugarcane Hybrid Clones on Weed Dynamics, Sugar Quality and Plant Crop Productivity in Badeggi Nigeria

Bassey, M.S[1].,. Shittu, E.A[2]., Lawan, Z.M[2]. and Eze J.N[1]
[1]Sugarcane Research Program, National Cereals Research Institute, P.M.B. 8, Badeggi, Nigeria
[2]Department of Agronomy, Bayero University Kano, P.M.B. 3011, Kano, Nigeria.
Corresponding e-mail: mosessamuel36@yahoo.com

Abstract
Plant varieties are primarily developed by plant breeders to increase yield and resistance to diseases/insects with little emphasis on weeds dynamics. This study was conducted to evaluate sugarcane hybrid clones for weed dynamics, sugar quality and plant crop productivity at the Upland Sugarcane Experimental Field of National Cereals Research Institute, Badeggi, Nigeria. A total of sixteen clones were planted on a Randomized Complete Block Design (RCBD) replicated three times. Analysis of variance showed significant differences among the clones for some traits. Our results revealed that *P. scrobiculatum* (Linn.), *S. pumila* (Poir.), *P. leucanthus* (Schum & Thonn), *B. diffusa* (L), *H. suaveolens* (Poit), *C. esculentus* (Linn.) and *K. squamulata* (Thorn.ex Vahl) were the major weed problems of sugarcane at Badeggi. Lower weed dry matter (0.18 g m^{-2}) , and taller plants (194.07 cm), higher cane yield (136.8 t ha^{-1}) and Sugar yield (12.93 t ha^{-1}) were found in BD -1098-003 m among the studied hybrids. BD 1098-005 m, BD 441-007 m and B 47419 possess higher fibre, these materials can be utilized for energy cane variety. Brix percent also varied among the clones with increase in age of crop, which can be used as an indicator for maturity. The results indicated that types of weed species and duration of infestation are major factors responsible for the decline in growth and yield attributes of sugarcane crop. The promising hybrids will be advance for more evaluation at different locations for yield and juice quality stability studies.

Keywords: *Cane yield, Growth, Hybrid clone, Juice quality, Sugarcane and Sugar*

Introduction

Sugarcane (*Saccharum officinarum* L.) is the most important sugar crop globally (Iqbal *et al.* 2020). The countries with the highest world production are: Brazil (41 %), India (16 %), China (6 %), and Thailand (6 %) (FAOSTAT, 2019). In tropical Africa, Mauritius, Kenya, Sudan, Zimbabwe, Madagascar, Ethiopia, Malawi, Zambia, Tanzania, Nigeria, Cameroun and DR Congo are the leading sugarcane producers (Katia *et al.*, 2019). In Nigeria, two types of sugarcane are produced: the industrial cane and the chewing cane. The industrial one is the major raw material used in the mills, while the chewing cane is mainly chewed in its natural form for its sweet juice but it can be processed into a variety of products such as sugar, molasses, baggasse "Jaggery" (*Mazarkwaila*), sweets (*Alewa*) used alone or mixed in foods (Bassey *et al*., 2021).

Development of varieties for different maturity groups is of paramount importance in sugarcane cultivation to realize higher recoveries in sugar mills (Priyanka *et al*., 2019). The proper choice of varieties, season and suitable agronomic technologies coupled with balanced nutrient application play an important role in sugarcane production. Non adoption of any one of the components leads to reduction in sugarcane production which in turn not only affects the cane growers and

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sugar mills, but also affects adversely the economy of the nation as a whole (Wakgari *et al*., 2020). The goal of sugarcane breeding programme is to increase sugar yield by increasing sugarcane production per unit area. According to Bassey *et al*. (2020), improvement in sugarcane production can only be achieved through the adoption of improved varieties and technologies. Seemingly Olaoye (2005), added that development of high sugar yield, pest and disease resistant cultivars, and weed suppressive ability can only be produced from sugarcane seedlings with genetically diverse parents or breeding clones for industrial production or by local chewing cane farmers. Increasing sugar content in sugarcane crop is closely associated with height, diameter and number of the stalks, along with sugar accumulation in the stalk as reported by Katia *et al.* (2012) and Mohammed *et al*. (2019).

Weeds constitute a major factor limiting sugarcane production in Nigeria. The competition for water, light, nutrients and space between weeds and the crop reduce sugarcane stalk population, yield (Bassey *et al*, 2021), deteriorate quality of crops (Ahmed *et al*., 2014; Bassey *et al*., 2017) and reduce farmers' income. Weeds pose tough competition to sugarcane crop because of wide spacing, slow germination and initial growth, heavy fertilization and frequent irrigations (Rafael *et al*., 2015). Initial slow growth and wider row spacing provide ample opportunity for weeds to occupy the vacant spaces between rows and offer serious crop- weed competition (Mahima and Bijnan, 2016). Singh *et al.* (2012) reported yield loss to an extent of 28 -38 % in ratoon crop due to weeds, and the most critical period for weed competition was between 30- 60 days after ratoon initiation. Weed can reduce sugarcane tonnage in the field, sucrose recovery in the mills and shortened ratoon lives (Chuadhari *et al*., 2016). The extent of loss in cane yield caused by weeds is from 10 % to total crop failure depending upon composition and diversity of weeds (Takim and Amodu, 2013).

Sugar yields have been generally improved by increased total biomass rather than directly by increasing sugar concentration in stalks. Aitken *et al*. (2008) stated that crop vigor and productivity of the ratoon crop are important traits to be considered in increasing sugar yield. Production and productivity of sugarcane is governed by varieties, season and agronomic package of practices besides balanced nutrition (Oni, 2016). Among the components, varieties play paramount role in sugar mills. Plant breeding programme develop varieties primarily to increase yield and resistance to diseases/insects with little emphasis on weeds dynamics. Hence, the importation of sugarcane varieties also takes advantage of the available high yielding sugarcane genotypes which may exhibit poor yielding ability in the new environment. One of the reasons for low yield may be poor competitive ability with the native weeds. The study reported herein was therefore undertaken to evaluate sugarcane hybrid clones on weed dynamics, sugar quality and plant crop productivity.

Materials and Methods

A field trial was conducted at the upland sugarcane experimental field of the National Cereals Research Institute, Badeggi (Lat. 9^o 45′N, Long. 06^o 07 E and 89 m above sea level) in the southern Guinea Savanna of Nigeria in 2017/2018 cropping season. The total rainfall during the experimental period was 1504.1 mm in 2017 and 1045.4 mm in 2018 while the mean air temperature was 36 to 38^o C in 2017 and 34 to 36^o C in 2018. Prior to cultivation, the land of the experimental site was manually cleared, ploughed and harrowed with a tractor in the first week of February 2017 and 2018. The land was fully irrigated before planting by pumping water from a stream using a 3.5 HP water pump with a 12.5 cm diameter hose. Thereafter, the land was marked out into plots with bunds at the edges for water retention. Fourteen promising clones (BD 140-02m, BD 140-011m, BD 140-014m, BD 1098-001m, BD 1098-003m, BD 1098-005m, BD 1098-014m, BD 441-004m, BD 441-007m, BD 575-007m, BD 1354-20m, BD 1576-31m, BD 1576-07m, BD 1576-14m) obtained from fuzz raising were advance from progeny testing II series to preliminary yield trial. The fourteen clones with two commercial varieties (B 47419 and N 27) were planted in a randomized complete block design (RCBD). Each plot size was 5 m x 6 m (30 m^2) consisting of 6 sugarcane rows and replicated three times. Each row was spaced at 1 m apart. Tender healthy young stalks of six months old sugarcane were used as planting material. The stalks were cut into setts each containing three eye buds, planted continuously end-to-end without intra-row spacing in shallow sunken bed. Sixty cane setts were planted per plot. Basal application of 120 kg ha^{-1} N fertilizer as urea, 60 kg P_2O_5 ha^{-1} as single superphosphate and 90 kg K_2O ha^{-1} as muriate of potash were split – applied. Half of N, P and K were applied at planting before mulching while the remnant was applied at 10 Weeks after planting (WAP) during the earthing up as a strip by the sugarcane stand in form of band placement. Fertilizers were applied by side banding at about 5 cm away from the seedlings and at about 5 cm deep along the row.

Weed species samples in each plot were collected from a $1m^2$ quadrat at 3, 6 and 9 months after planting (MAP). Weed species seedlings in each quadrat were clipped at the soil level and identified according to Akobundu *et al.* (2016). The composition of the weed flora was analyzed by calculating the relative abundance (RA) of each species as follows:

$$\mathrm{R.A} = \frac{Total\ number\ of\ individual\ of\ a\ species\ in\ all\ the\ quadrats}{Total\ number\ of\ quadrats\ in\ which\ the\ species\ occurred}$$

$$= \sum \frac{WI}{n}$$

Where $\sum$ Wi is the sum of individual of a species occurring in all the quadrats, "n" is the number of quadrats in which the species occurred (Das, 2011). The weed species were counted to determine the weed density on plot basis and expressed in number per m^2. The weed samples were oven dried at 80 ^{0} C to a constant weight and weighed to determine the dry matter in g per m^2.

Data was collected on germination and establishment (%) at 21 and 42 days after planting (DAP) respectively, tiller count at 3 months after planting (MAP). Sugarcane stalk height (cm) at 9 MAP was taken from the soil level to the tip of the last unfolded leaf using a graduated ruler. Stalk girth (cm) at 10 MAP was taken using Vernier caliper. Per cent Brix at harvest (12 MAP) was taken using hand refractometer to determine the level of soluble sugar. Millable cane and Yield (t ha^{-1}) were taken at harvest from the harvested stalks and weighed. Cane juice was analyzed for purity, polarity, sucrose, glucose, fibre and Estimated Recoverable Sucrose percent (ERS). The Estimated Recoverable Sucrose percent (ERS) and smut incidence were analyzed as follows:

Recoverable Sucrose percent (RS)

$$\mathrm{RS}\ (\%) = \frac{Pol\% - (Brix - Pol) \times JF}{2}$$

Juice Factor = 0.65, Pol = Polarity (Islam *et al*., 2011).

$$\text{Sugar Yield (t/ha)} = \frac{Cane\ Yield\ t\ ha{-1} \times Recovery\ Sucrose}{100}$$

All data collected were subjected to analysis of variance (ANOVA). Treatment means were separated using the Least Significant Difference (LSD) at 5 % level of probability using SAS version 9.0 statistical packages.

Results and Discussion

In 2017 cropping seasons, the most abundant weed species across the experimental field was *Paspalum scrobiculatum* (Linn.)(Table 1). However, across the treatments in 2017, the most consistent and abundant weed species were *Paspalum scrobiculatum* (Linn.), *Kyllinga squamulata* (Thorn ex. Vahl.), *Setaria pumila* (Poit.), *Imperata cylindrical* (Linn.), *Cenchrus biflorus* (L.), *Cynadon dactylon* (Linn.). Furthermore, as the season advanced from 6 to 9 MAP, the most consistent and abundant weed species were *Schwenckia americana* (L.), *Hyptis suaveolens* (Poit.), *Imperata cylindrical* (Linn.), *Paspalum scrobiculatum* (Linn.), *Digitaria milanjiana* (Wild.) and *Kyllinga squamulata* (Thorn. ex Vahl) only. The following weeds were early emergents but are not seen at the end of the season: *Cynadon dactylon* (L), *Cenchrus biflorus* (L), *Dactyloctenium aegyptium* (L), *Euphorbia hirta* (L), *Cleome viscose* (L), *Trichodesma zeylanium* (L), *Cyperus rotundus* (L) and *Phyllanthus pentandrus* (Schum & Thonn), *Eragrostis tenella* (Linn.) P.Beauv.

In 2018, the most abundant weed species observed were *Paspalum scrobiculatum* (Linn.), *Cenchrus biflorus* (L.), *Dactylactenum aegyptium* (Linn), *Kyllinga squamulata* (Thorn.

ex Vahl), *Eleusine indica* (L) and *Setaria babarta* (L.) (Table 1). At 6 to 9 MAP across the season, the abundant weed species identified were *Cyperus esculentus* (Linn.), *Hytis suaveolens* (Poit.), *Phyllanthus leucanthus* (Schum & Thonn), *Boerhovia diffusa* (L.), *Digitaria horizontalis* (Wild.) and *Brachiaria deflexa* (Schumach). *Digitaria milanjiana* (Wild.), *Cenchrus biflorus* (L), *Setaria pumila* (Poit), *Panicum maxicum* (Jacq.), *Pennisetum pedicellatum* (Trin), *Eleusine indica* (L.), *Andropogon gayanus* (Schum & Thonn), *Setaria verticilillata* (Lam.) Kunth, *Brachiaria jubata* (Fig. & De Not), *Euphorbia heterophylla* (L) and *Kyllinga squamulata* (Thorn.) were early emergents, but are not seen at the end of the season.

Weed dry matter (DM) in the plant crop differed significantly between sugarcane hybrid clones (Table 2). Least weed dry matter (0.41 g/cm^2) was observed in BD 1576-07m, which did not differ significantly with weed dry matter obtained in BD 1098-005m (0.43 g/cm^2), BD 1576-14m (0.43 g/cm^2), B 47419 (0.45 g/cm^2), N 27 (0.47 g/cm^2) and BD 1098-003m (0.47 g/cm^2) genotype at 3 MAP compared with others. However, at 9 MAP, sugarcane genotype BD - 1098-003 m had significantly ($P>0.05$) lower weed dry matter which differed with weed dry matter in other genotypes except in values obtained in BD 1354-20m (0.51 g/cm^2), BD 1576-31m (0.36 g/cm^2), BD 140-014m (0.35 g/cm^2) and BD 1098-014m (0.33 g/cm^2) genotypes. It was also observed that weed dry matter reduced across the cropping season with the age of the crop.

Germination percentage was significantly ($P< 0.05$) different between the sugarcane hybrid clones in the year of study (Table 3). The sugarcane genotype BD 140-014m produced highest germination percentage than other clones tested except BD 1098-014m, BD 441-007m, and N 27. Furthermore, BD 140-014m had more established plants (70.3%) which was similar to BD 1098-014m and BD 441-007m, and were significantly higher than other sugarcane clones studied except BD 1098-005m, BD 575-007m, BD 1354-20m, BD 1576-31m, BD 1576-07m and BD 1576-14m. Similarly, BD 441-007m obtained the highest number of tillers (127.67) which was significantly the same with BD 1098-014m while BD 1576-31m had the lowest number of tillers (19) from all the studied clones. Sugarcane plant height was significantly ($P< 0.05$) different between the sugarcane hybrid clones in the year of study (Table 3). There was no significant sugarcane genotype effect in plant height.

Sugarcane stalk per stool was significantly ($P<0.05$) higher in BD 140-014m than other sugarcane hybrids clones tested except BD 1098-014m, BD 1354-20m and BD 1576-31m (Table 4). Similarly, BD 140-014m hybrid had bigger stalks which were at par with BD 1098-005m, both hybrids were significantly bigger in stalks than other hybrid clones tested (Table 4). Furthermore, BD 140-011m had more number of milleable stalks (113) per plot which were similar to BD 1098 - 001m hybrid clone. The highest cane yield (136.8 t/ha) was found in BD 1098-003m which was significantly higher than the cane yield of other tested hybrid clones except BD 1098-001m, BD 1098-014m and N 27 (Table 4).

Higher brix content was obtained in BD 1098-001m hybrid clone compared with that from other clones (Table 5). The trend of brix accumulation for hybrid clones like BD 140-02m, BD 140-011m, BD 140-014m, BD 1098-001m, BD 1098-003m, BD 1098-005m, BD 575-007m, BD 1576-31m, BD 1576-07m, BD 1576-14m and B 47419, increase with increase in age of the crop. There was a significant difference in juice quality among all the entries (Table 6). BD 1098-003m had the highest moisture percent (73.03) while BD 1098-005m had the lowest (57.90). Maximum fibre content was found in hybrid BD 1098-005m and lowest in BD 1098-003m.

Furthermore, Sucrose and Glucose percentage were significantly ($P< 0.05$) higher in BD 1354-20m than other hybrid clones tested. The polarity of BD 1576-14m (22.47) and BD 1354-20m (22.25) were significantly higher than other clones studied except N 27. Maximum purity percent of 93.6 was obtained from BD 1576-14m compared with that from other clones. Maximum recoverable sucrose was found in BD 1576-14m compared with that from other clones. Sugar yield differs among the hybrid clones, BD 1098-003m, BD 1098-001m, gave higher yield than the other hybrids and the checks varieties (N 27 and B 47419).

Consequently, the most abundant weed species found in the field of study was *C. esculentus* (Linn.). Furthermore, *P. scrobiculatum* (Linn.) was in abundance in 2017. These results imply that *C. esculentus* (Linn.) and *P. scrobiculatum* (Linn.) Weed species were perennials and rhizomatous in nature which makes them adaptable in sugarcane fields. Sedge weeds are the most harmful class of weed species found in sugarcane. Takim *et al*. (2014) stated that *Cyperus* spp is a major weed problem in sugarcane field in the tropics. Weed species such as *P. scrobiculatum* (Linn.), *S. pumila* (Poir.), *P. leucanthus* (Schum & Thonn), *B. diffusa* (L), *H. suaveolens* (Poit), *C. esculentus* (Linn.) and *K. squamulata* (Thorn.ex Vahl) were among the most abundant across all weed species studied. It is interesting to note that grass weed species were relatively abundant during the rainy season of 2017 because of the high amount of moisture received through rainfall in this year. This results indicate that the grass weed species had a hospitable environment, especially that the weed species have similar phenological and physiological similarities to the sugarcane crop during the vegetative phase (Takim *et al*. 2013). The most abundant broadleaved weed species present in the sugarcane field, C. *diffusa* Burm., *C. benghalensis* L. were more visible in 2017 while *P. niruri* Schum & Thorn., *H. suaveolens* Poit and *B. diffusa* L. were more visible in 2018. These weed species may require more weed management attention or may become competitive and inhibit the growth and yield of sugarcane. This result is consistent with the work of Khaliq *et al*. (2018) who stated that weed species types and their duration of infestation are among the numerous factors responsible for the reduction in growth and yield attributes of sugarcane crop. In general, weed species were more and visible in the sugarcane field in 2017 than 2018. This might be due to the changes in environmental conditions, history of the cropping system, tillage and weed management practiced, which might have been responsible for the variation in weed species emergence and magnitude. A similar trend was reported by Takim and Amodu (2013).

The superiority of BD -1098-003 m hybrid in reducing weed growth compared to other hybrid clones could be attributed to higher tillering ability, quicker canopy formation, heavy residue production, heavy stooling ability, drought tolerance and better weed suppressive ability. This finding is in agreement with the work of Uwah and Iwo (2011) and Naidu *et al*. (2017) who stated that genetically improved cane adapts easily, suppresses weed germination and retard growth and development of many weeds. This result is also in agreement with the works of Vitti *et al*. (2010) and Concenco *et al*. (2016), who found significant variation among sugarcane genotypes to reduction in weed dry matter.

The difference in growth parameter in the tested sugarcane hybrid clones could be attributed to its superior genetic potential and efficient use of applied inputs. It could also be attributed to higher tillering ability, quicker canopy formation, heavy residue production, heavy stooling ability, drought tolerance and better weed suppressive ability. The variation in number of sprouts, establishment and tillering could also be due to different leaf architecture and growth habit. Similar results were reported by Shah *et al*. (2009), Bashir *et al*. (2012) and Hassan *et al*. (2017) who found significant variation among the ratoons of different sugarcane genotypes for number of sprouts and establishment.

This significant difference noted among the studied genotypes in plant height was in accordance with the findings of Arain *et al*. (2011), who observed significant differences for plant height while evaluating 11 sugarcane clones for qualitative and quantitative traits under the agro-climatic condition of Thatta. Kuri and Chandrashekar (2015) also attributed significant differences noted among the studied genotypes to be controlled by its superior genetic potential and efficient use of applied inputs. Our results is in line with the work of Bassey *et al*.

(2020), who revealed significant differences in sugarcane growth parameters among fifteen sugarcane genotypes. The researchers reported high establishment count, plant height and number of stools of different sugarcane genotypes in their studies.

The disparity in the number of stools per plot and stalk length might be ascribed to better growth and diverse morphology of the genotypes. These results corroborates with the result obtained by Muhammad *et al*. (2014), who reported similar finding on sixteen sugarcane genotypes in Pakistan.

High stalk girth and cane yield demonstrated by some genotypes in this study could be ascribed to diverse genetic composition of the clones as a result of wide genetic differences of their parents. Katia *et al*. (2019) stated that higher cane yield is the function of higher genetic potential of a variety. Our findings are in line with the work of other researchers that found significant differences in cane yield among some sugarcane genotypes. Muhammad *et al*. (2014) and Bassey *et al*. (2019), reported high cane yield of different sugarcane genotypes in their respective studies. Variability among the clones for yield per hectare is in agreement with report of other researchers (Getaneh *et al*., 2015 and Ali *et al*., 2017).

The sugar content of some genotypes increased with age of sugarcane crop. This is usually used to ascertain maturity period of sugarcane genotypes. The discrepancy in brix content might be due to the presence of superior genetic potential and the uniform expression of genes. Our results corroborates with the report of a study carried out in Nigeria by Kwajaffa and Olaoye (2014), which showed significant variation in brix content among 20 genotypes (from 17.8 to 25.0 %).

Variation among the studied hybrids for juice quality could be attributed to higher genetic potential of their parent for the trait. Several workers have reported significant difference among sugarcane genotypes for sugar juice quality. Khan *et al*., (2018) reported differences in moisture percentage, fibre, brix, sucrose and juice purity of sixteen varieties. Islam *et al*., (2011) stated same trend on purity (75.9 % to 89.3 %) and polarity (12.0 % to 13.4 %) disparity among six sugarcane genotypes. Our results are in agreement with the work of Bassey *et al.*, (2020), who found that it is difficult to achieve high cane yield and sugar recovery in the same genotype. The disparity in the recovery sucrose of evaluated clones confirms the report of Khan *et al*., (2018). The family of BD 1098m clone performs better in sugar yield, which can be related to higher genetic potential of their parent for the trait. Several workers had also reported significant difference among sugarcane varieties for sugar yield (Getaneh *et al*., 2015 and Bassey *et al*., 2020).

Conclusion

Weed species types and duration of infestation are major factors responsible for the decline in growth and yield attributes of sugarcane crop. The genotypes BD 1098-001, BD 1098-003, BD 1098-005 and BD 1098-014 that showed high cane yield and estimated recovery sucrose (ERS) can be selected for more evaluation under different ecologies. The clones with high fiber and good sugar yield can also be dedicated for dual purposes (for sugar and ethanol production) since no variety has been release for such purpose in Nigeria. The time of highest Brix percent of a sugarcane clone can serve as indicator for crop maturity in non-flowering condition. The promising hybrids will be advance for more evaluation at different location for yield and juice quality stability studies

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Table 1. Mean relative abundance (%) of weed species encountered in sugarcane field in 2017 and 2018 cropping seasons

Weed species	Relative abundance (%) Months Months after planting					
	2017			2018		
	3	6	9	3	6	9
Grassess						
Paspalum scrobiculatum (Linn.)	34.37	8.68	5.52	29.02	6.83	6.86
Imperata cylindrica (Linn.)	16.79	9.0	8.80	15.60	-	10.67
Cynadon dactylon (Linn.)	13.86	2.0	-	9.33	8.12	19.57
Digitaria milanjiana (Wild.)	1.0	7.13	2.8	16.5	-	-
Cenchrus biflorus (L.)	10.29	5.27	-	27.33	24.0	-
Setaria pumila (Poit)	18.47	1.50	5.33	38.80	-	-
Dactyloctenium aegyptium (Linn.)	8.0	2.40	-	25.75	8.18	9.81
Panicum maxicum (Jacq.)	2.0	1.60	2.5	25.67	-	-
Pennisetum pedicellatum (Trin)	-	3.0	-	13.0	-	-
Eleusine indica (L.)	1.0	-	-	25.13	5.56	-
Andropogon gayanus (Schum & Thonn)	-	-	-	29.0	-	-
Setaria verticilillata (Lam.)Kunth	-	-	-	8.67	-	-
Setaria barba (Lam.)Kunth	-	-	-	28.0	21.41	-
Digitaria horizontalis (Wild.)	-	-	-	22.53	6.17	16.50
Brachiaria jubata (Fig. & De Not)	-	-	-	22.86	-	-
Brachiaria deflexa (Schumach) C.E	-	-	-	30.35	-	14.29
Broadleaves						
Tridax procumbens (Linn.)	3.11	4.72	5.47	4.67	2.0	2.0
Schwenckia americana (L.)	9.80	9.73	5.69	8.80	2.0	5.20
Leucas martinicensis (Jasq.)Ait.f	1.67	1.82	1.69	-	2.0	2.0
Hyptis suaveolens (Poit)	4.22	6.25	2.27	3.33	21.89	16.63
Indigofera hirsute (Linn.)	1.67	3.42	1.75	-	2.46	-

Boerhovia diffusa (L.)	2.25	1.0	3.29	-	11.75	38.33
Rottboellia cochinchinensis (Lour.)	3.33	4.33	2.73	-	2.0	2.67
Euphorbia hirta (Linn.)	3.0	1.0	-	4.67	-	-
Cleome viscose (L.)	1.67	2.11	-	7.0	2.0	-
Euphorbia heterophylla (Linn.)	1.0	2.50	2.13	5.0	2.0	-
Trichodesma zeylanium ( )	2.0	2.71	-	-	3.33	-
Tephrosia pedicelata (Bak.)	-	3.24	2.33	2.50	-	5.0
Corchorus olitorius (L.)	-	2.50	1.8	3.0	2.0	6.14
Senna obtusifolia (L.)	-	1.0	1.56	-	2.0	-
Sebestina chamaelea (L.)Muell.Arg	-	1.60	4.0	18.33	-	4.0
Ipomoea asarifolia (Desr.) Roem	-	2.77	1.25	4.0	3.33	-
Desmodium tortuosum (Sw.) DC	-	4.0	1.13	6.0	-	-
Calopogonium mucunoides (Desv.)	-	1.33	1.0	-	-	4.0
Sesamum alatum (Thonning)	-	1.0	-	-	16.0	4.0
Acalypha segetalis (Schum & Thonn)	-	3.38	1.0	-	-	-
Stylosanthus hamata (L.) Taub.	-	1.33	1.0	-	2.50	-
Physalis angulata (Linn.)	-	1.0	-	4.0	8.67	2.0
Daniella oliveru (Rolfe) Hutch & Dalz	-	1.0	-	-	2.0	-
Gomphrena celosiodes (Mart.)	-	5.0	-	-	-	6.0
Eragrostis tenella (Linn.) P.Beauv.	8.0	-	-	22.0	-	-
Ageratum coryzoides (Linn.)	1.0	-	-	11.0	-	-
Spernacea semensis ( )	2.0	-	-	-	-	-
Mitracarpus villosus (Sw.) DC	2.0	-	1.0	-	2.0	-
Oldenlandia herbacea (Linn.)		-	-	-	2.67	-
Commelina benghalensis (L.)	2.25	4.18	2.0	10.40	3.0	7.76
Phyllanthus leucanthus (Schum & Thonn)	1.50	3.08	2.0	-	20.0	11.09
Phyllanthus pentandrus (Schum & Thonn)	3.0	5.44	-	-	-	-
Sedges						
Cyperus rotundus (Linn.)	3.0	2.0	-	5.0	8.75	-
Cyperus esculentus (Linn.)	2.67	5.93	3.0	16.40	26.75	10.59
Kyllinga squamulata (Thorn.ex Vahl)	25.50	6.26	2.80	36.0	4.0	-

Source: Weed Survey 2017 and 2018

Table 2. Mean values on weed dry weight (g m^{-2}) at 3, 6 and 9 months after planting (Combined year effect)

Genotypes	3 MAP	6 MAP	9 MAP
BD 140-02m	0.55	0.42	0.26
BD 140-011m	0.54	0.44	0.27
BD 140-014m	0.67	0.54	0.35
BD 1098-001m	0.59	0.46	0.26
BD 1098-003m	0.47	0.35	0.18
BD 1098-005m	0.43	0.37	0.22
BD 1098-014m	0.60	0.49	0.33
BD 441-004m	0.55	0.44	0.26
BD 441-007m	0.53	0.41	0.26
BD 575-007m	0.43	0.37	0.22
BD 1354-20m	0.82	0.68	0.51
BD 1576-31m	0.73	0.53	0.36
BD 1576-07m	0.41	0.39	0.24
BD 1576-14m	0.43	0.36	0.23
N 27	0.47	0.38	0.24

B 47419	0.45	0.36	0.27
CV %	4.5	18.7	15.2
LSD (0.05)	0.06	0.05	0.12

Table 3: Mean values for growth performance of selected hybrid sugarcane genotypes (Combined year effect)

Genotypes	Germination (%)	Establishment (%)	Tiller	Plant height (cm)
BD 140-02m	49.33	49.30	71.33	156.53
BD 140-011m	37.67	50.33	68.33	189.80
BD 140-014m	64.00	70.33	106.00	187.80
BD 1098-001m	37.00	51.00	56.00	184.33
BD 1098-003m	46.00	59.67	76.33	194.07
BD 1098-005m	29.67	34.33	19.00	167.53
BD 1098-014m	58.00	68.33	124.00	143.27
BD 441-004m	38.33	39.33	64.67	186.33
BD 441-007m	50.67	66.33	127.67	158.87
BD 575-007m	18.33	31.33	61.67	151.00
BD 1354-20m	17.67	17.67	41.67	168.07
BD 1576-31m	9.33	15.00	20.00	157.60
BD 1576-07m	20.00	16.33	55.67	144.40
BD 1576-14m	24.33	32.67	50.67	167.80
N 27	51.33	55.67	92.00	191.467
B 47419	46.33	51.67	57.33	187.60
CV %	28.5	47.10	81.00	24.00
LSD (0.05)	17.78	34.80	92.17	NS

CV - coefficient of variation, LSD - least significant difference, NS- Not significant

Table 4: Mean values for yield performance of selected hybrid sugarcane genotypes (Combined year effect)

Genotypes	Stalk stool^{-1}	Stool plot^{-1}	Stalk girth (cm)	Millable cane	Cane yield (t ha^{-1})
BD 140-02m	4.67	19.67	2.10	92.33	81.7
BD 140-011m	9.87	15.00	2.33	113.33	101.0
BD 140-014m	5.00	25.67	2.83	81.33	100.3
BD 1098-001m	6.13	15.00	2.23	110.00	116.7
BD 1098-003m	5.87	20.67	1.97	106.00	136.8
BD 1098-005m	5.57	12.00	2.80	54.00	85.7
BD 1098-014m	7.40	13.33	2.03	101.33	118.0
BD 441-004m	6.80	13.33	1.97	104.67	81.3
BD 441-007m	6.00	19.33	2.03	102.67	102.7
BD 575-007m	6.67	14.00	2.23	81.00	84.3
BD 1354-20m	7.63	14.00	2.43	74.33	83.7
BD 1576-31m	7.33	12.33	2.10	63.33	77.3
BD 1576-07m	7.03	8.33	2.37	62.00	85.0
BD 1576-14m	4.67	13.00	2.10	88.33	78.7
N 27	6.87	15.33	2.37	97.33	119.3
B 47419	5.13	8.67	1.93	103.33	71.7
CV (%)	26.50	62.70	12.30	57.50	15.70
LSD (0.05)	2.78	NS	0.46	NS	31.60

CV - coefficient of variation, LSD - least significant difference

Table 5: Trend of brix (%) accumulation for hybrid sugarcane genotypes (Combined year effect)

Genotypes	Brix 8 MAP	Brix 10 MAP	Brix 12 MAP
BD 140-02m	15.27	18.43	19.30
BD 140-011m	15.13	15.63	17.50
BD 140-014m	14.53	17.03	17.63
BD 1098-001m	17.13	20.67	21.40
BD 1098-003m	17.88	18.10	18.87
BD 1098-005m	14.33	18.43	20.60
BD 1098-014m	16.53	19.00	19.43
BD 441-004m	15.13	19.27	19.47
BD 441-007m	15.07	18.83	17.30
BD 575-007m	15.00	18.83	19.90
BD 1354-20m	9.87	16.73	16.27
BD 1576-31m	12.40	17.07	21.13
BD 1576-07m	14.07	18.23	18.70
BD 1576-14m	14.33	15.77	17.83
N 27	16.73	19.07	18.57
B 47419	14.30	16.73	17.33
CV (%)	19.80	9.10	10.10
LSD (0.05)	4.91	2.72	3.18

CV - coefficient of variation, LSD - least significant difference, MAP- months after planting

Table 6a: Juice quality of hybrid sugarcane genotypes (Combined year effect)

Genotypes	Moisture (%)	Fibre (%)	Brix (%)	Sucrose (%)
BD 140-02m	67.87	10.93	21.20	20.82
BD 140-011m	67.16	12.74	20.10	19.85
BD 140-014m	68.33	11.55	20.12	18.87
BD 1098-001m	63.01	13.99	23.00	20.39
BD 1098-003m	73.03	5.37	21.60	18.40
BD 1098-005m	57.90	16.90	25.20	22.76
BD 1098-014m	65.41	10.59	24.00	19.19
BD 441-004m	64.00	11.40	24.60	23.12
BD 441-007m	64.10	14.90	21.00	19.70
BD 575-007m	65.30	11.70	23.00	21.32
BD 1354-20m	60.45	13.05	26.50	24.79
BD 1576-31m	62.85	14.15	23.00	21.66
BD 1576-07m	66.17	12.83	21.00	18.64
BD 1576-14m	64.64	11.36	24.00	24.75
N 27	69.79	9.21	21.00	17.09
B 47419	63.59	15.21	21.20	18.37
CV (%)	8.6	4.5	4.3	4.8
LSD (0.05)	7.9	3.2	1.4	1.9

CV - coefficient of variation, LSD - least significant difference

Table 6b: Juice quality of hybrid sugarcane genotypes (Combined year effect)

Genotypes	Glucose (%)	Polarity (%)	Purity (%)	Recoverable Sucrose	Sugar Yield (t/ha)
BD 140-02m	26.03	19.15	89.50	11.78	9.62
BD 140-011m	24.82	18.29	87.9	11.13	10.06
BD 140-014m	23.60	17.44	86.30	10.47	10.50
BD 1098-001m	25.50	18.59	80.80	10.65	12.43
BD 1098-003m	23.02	16.89	78.40	9.45	12.93
BD 1098-005m	28.46	21.64	85.70	12.91	11.06
BD 1098-014m	23.93	17.48	72.60	9.24	10.90
BD 441-004m	28.91	20.99	85.30	12.47	10.14
BD 441-007m	24.63	18.13	86.40	10.85	11.14
BD 575-007m	26.64	19.46	84.60	11.49	9.69
BD 1354-20m	31.04	22.25	85.40	13.08	10.95
BD 1576-31m	27.08	19.80	86.10	11.83	9.14
BD 1576-07m	23.33	17.21	81.90	9.95	8.46
BD 1576-14m	30.94	22.47	93.60	14.11	11.10
N 27	21.43	16.09	76.40	8.86	10.57
B 47419	22.98	16.91	79.70	9.59	6.88
CV (%)	2.1	5.2	4.9	4.6	4.2
LSD (0.05)	12.2	5.8	9.8	1.4	1.2

CV - coefficient of variation, LSD - least significant difference