Research Paper

ADVANCE RESEARCH JOURNAL OF
CROP IMPROVEMENT
Volume 4 | Issue 2 | December, 2013 | 98-102

Effect of sheath moisture and relation of SPAD on yield of sugarcane

K.V. KESHAVAIAH, Y.B. PALLED[1], C. SHANKARAIAH AND B.S. NANDIHALLI[2]

AUTHORS' INFO

Associated Co-author :

[1]Department of Agronomy and Fodder Scheme, University of Agricultural Sciences, DHARWAD (KARNATAKA) INDIA

[2]Department of Agricultural Entomology, College of Agriculture, BIJAPUR (KARNATAKA) INDIA

Author for correspondence :
K.V. KESHAVAIAH
Zonal Agricultural Research Station, V.C. Farm, MANDYA (KARNATAKA) INDIA

ABSTRACT : An experiment was conducted at Zonal agricultural Research Station, V.C. Farm, Mandya during 2007-08 to study the relationship of nutrient management practices and varieties of sugarcane on sheath moisture, SPAD chlorophyll values and ultimately yield of sugarcane. The results revealed that sheath moisture was higher after 6 months of planting and showed a decline with the maturity of the crop. The SPAD values recorded were higher with Co 62175 (41.74) over Co 86032 (39.32). The sheath moisture and SPAD are indicators of cane yield as Co 62175 variety (149.40 t/ha) over Co 86032 (130.05 t/ha) and recommended package of practices nutrient management have resulted in higher cane yield (174.82 t/ha) over organic nutrient management practices.

Key Words : Sheath moisture, SPAD chlorophyll values, Nutrient management

How to cite this paper : Keshavaiah, K.V., Palled, Y.B., Shankaraiah, C. and Nandihalli, B.S. (2013). Effect of sheath moisture and relation of SPAD on yield of sugarcane. *Adv. Res. J. Crop Improv.*, **4** (2) : 98-102

Paper History : Received : 01.07.2013; **Revised :** 19.10.2013; **Accepted :** 06.11.2013

Sugarcane, a complex hybrid of *Saccharum* spp., is one of the important commercial crops of industrial importance next only to cotton in India. Sugarcane occupies a pivotal position in the agricultural economy of India. As an instrument of agrarian reform and economic emancipation, sugarcane is second to none. This is so because, it is a labour intensive crop and provides livelihood to millions through an organized industry that it carries with it in the rural India. Sugarcane in agricultural sector shares seven per cent of total value of agricultural output and occupies only 2.5 per cent of Indian gross cropped area. In the country, there are 571 sugar industries in operation in rural areas.

India is next only to Brazil with respect to cane area and production as well of sugar production. Though, there is a wide variation with productivity across different regions (Anonymous, 2010). Karnataka is a leading sugarcane growing state with high sugarcane production potentialities particularly in the sugarcane growing Cauvery command area. In the state, it is cultivated in four lakh hectares with a productivity of 90 tonnes /ha which is well above the national average. However, there is still a lot of scope for increasing the productivity as compared to neighbouring Tamil Nadu state, where the productivity (109 tonnes /ha) is highest in the country. Among various yield enhancing factors in sugarcane, sheath moisture is very important as higher sheath moisture at initial stages of crop growth and decline in sheath moisture at harvest are good indicators of obtaining higher sugarcane yields.

Rate of growth of young cane is a good indicator of availability of nutrients. Moisture content of leaf sheath moisture is essential if the plant is to grow rapidly. The content of leaf sheath moisture is dependent on availability of soil moisture. In addition, moisture content of leaf sheath tissue is affected by balance between the nutrients nitrogen, phosphorus potash, calcium and other nutrients to the plant as well as external conditions of aeration and structure of soil.

With adequate water supply to maintain a leaf sheath moisture of 84-85 per cent in the leaf sheaths of 3, 4, 5 and 6 from top during the period of active growth produces longest internodes with more girth and total cane weight is greater.

In ripening phase, a restricted water supply or mild water deficit is necessary to bring the crop to maturity by reducing the rate of vegetative growth, dehydrating the cane forcing the conversion of total sugars to recoverable sugar. The moisture status of leaf sheath, being positively correlated to

growth may be regarded as indicative of the sucrose / reducing sugar ratio. Similarly it is indicative of high reducing sugar content, thus being associated with rapid growth.

SPAD chlorophyll metre values are indicative of overall health of the crop. Higher the values, greener will be the plant, it is indicative of better growth of crop. SPAD values and sheath moisture have direct relation to the over all sugarcane growth and ultimately the yield of crop.

Considering the importance of sheath moisture and SPAD chlorophyll metre values, a study was taken up in the plant crop of sugarcane to observe its effect on yield of cane.

RESEARCH PROCEDURE

The experiment was laid out in the plot number 99 of D block of the Zonal Agricultural Research Station (ZARS), V.C.Farm, Mandya under the University of Agricultural Sciences, Bangalore. The station is situated between $12^0$18' and $13^0$04' north latitude and $76^0$79' and $77^0$20' east longitude and at an altitude of 695 metres above mean sea level in the Agro-climatic zone-6 (Southern dry zone) of region III of Karnataka. Before taking up the planting of sugarcane, cowpea was sown in the experimental area. The sugarcane plant crop was planted on 16th August, 2007 and harvested during 27th August, 2008. The experiment was laid out in split plot design with two varieties Co 62175 (V1) and Co 86032 (V2) as main plot treatments and the nutrient management practices (both organic and inorganic) as sub plot treatments. The sub plot treatments are as under. The data were analysed by adopting analysis of variance technique as per Panse and Sukatme (1976).

Sub - plot treatments :

N_1	Pressmud (150 kg N equivalent/ha)	Sunnhemp(50 kg N equivalent/ha)		Biofertilizers (50 kg N equivalent/ha)
N_2	Pressmud (100 kg N equivalent/ha)	Farmyard manure (100 kg N equivalent/ha)		Biofertilizers (50 kg N equivalent/ha)
N_3	Pressmud (75 kg N equivalent/ha)	Farmyard manure (75 kg N equivalent/ha)	Frenchbean as intercrop (50 kg N equivalent/ha)	Biofertilizers (50 kg N equivalent/ha)
N_4	Pressmud (87.5 kg N equivalent /ha)	Farmyard manure (87.5 kg N equivalent/ha)	Neem cake (25 kg N equivalent/ha)	Biofertilizers (50 kg N equivalent/ha)
N_5	Pressmud (87.5 kg N equivalent /ha)	Farmyard manure (87.5 kg N equivalent/ha)	Vermicompost (25 kg N equivalent/ha)	Biofertilizers (50 kg N equivalent/ha)
N_6	50% N equivalent through organic and 50% NPK through chemical fertilizers			
	Pressmud (75 kg N equivalent/ha)	Chemical fertilizer (125 kg N, 50 kg P and 62.5 kg K_2O/ha)		Biofertilizers (50 kg N equivalent/ha)
N_7	Recommended package of practices			
	Chemical fertilizers (250 kg N : 100 kg P_2O_5 : 125 kg K_2O/ha)	Farmyard manure (25 t/ha)		
N_8	Chemical fertilizers alone (250 kg N : 100 kg P_2O_5 : 125 kg K_2O/ha)			

Estimation of leaf sheath moisture content :

Five leaves were collected from the main plants from each treatment in three replications and leaf sheaths were separated from the leaves. Fresh weight of the leaf sheath was taken and the samples were oven dried at 80^0C and the dry weight of the

Table 1: Sheath moisture (%) at 6 months, 9 months and harvest as influenced by nutrient management practices in plant crop of sugarcane

Nutrient management practices (N)		Sheath moisture at 6 months		Mean	Sheath moisture at 9 months		Mean	Sheath moisture at harvest		Mean
		Varieties			Varieties			Varieties		
		V_1	V_2		V_1	V_2		V_1	V_2	
N_1	Pressmud + sunnhemp + biofertilizers	86.19	82.20	84.20	77.76	75.13	76.54	74.72	75.00	74.86
N_2	Pressmud + FYM + biofertilizers	86.04	83.35	84.69	77.73	75.51	76.61	75.33	75.34	75.34
N_3	Pressmud + FYM + French beans + biofertilizers	86.39	84.03	85.21	79.07	72.87	75.94	75.69	75.33	75.51
N_4	Pressmud + FYM + neem cake + biofertilizers	86.83	83.69	85.26	75.01	76.18	75.59	76.00	74.67	75.33
N_5	Pressmud + FYM + vermicompost + biofertilizers	84.72	84.65	84.68	76.65	77.82	77.23	74.33	74.00	74.17
N_6	50% N through pressmud + 50% NPK through fertilizer + biofertilizer	87.19	82.23	84.71	78.07	76.65	77.33	76.00	75.36	75.68
N_7	Recommended package of practices	87.55	83.74	85.64	75.67	75.57	75.62	74.67	75.67	75.17
N_8	100% NPK through fertilizers only	88.17	86.19	87.14	78.57	73.30	75.94	75.67	74.33	75.00
	Mean	86.64	83.75	-	77.33	75.37	-	75.30	74.96	-
		S.E.m ±	C.D. (P=0.05)		S.E.m ±	C.D. (P=0.05)		S.E.m ±	C.D. (P=0.05)	
	Varieties (V)	0.54	NS		0.14	0.41		0.13	NS	
	NMP (N)	0.83	NS		1.08	NS		0.48	NS	
	V × N	1.17	NS		1.52	NS		0.67	NS	
	N × V	1.22	NS		1.43	NS		0.64	NS	

V_1 = Co.62175 V_2 – Co.86032

sample was taken. The per cent leaf sheath moisture was calculated by using the formula :

$$\text{Leaf sheath moisture (\%)} = \frac{\text{Fresh weight} - \text{dry weight}}{\text{Dry weight}} \times 100$$

SPAD chlorophyll reading :

SPAD chlorophyll meter readings were recorded at middle lamina of the index leaves 3,4,5 and 6th fully opened leaves from the top of millable cane from five canes at random at 6th and 9th month and at harvest after planting because this leaf is highly related to the nitrogen status of sugarcane plants (Clement, 1977).

RESEARCH ANALYSIS AND REASONING

The sheath moisture recorded during the three periods of observation, 6th month, 9th month and harvest is presented in Table 1 and Fig. 1.

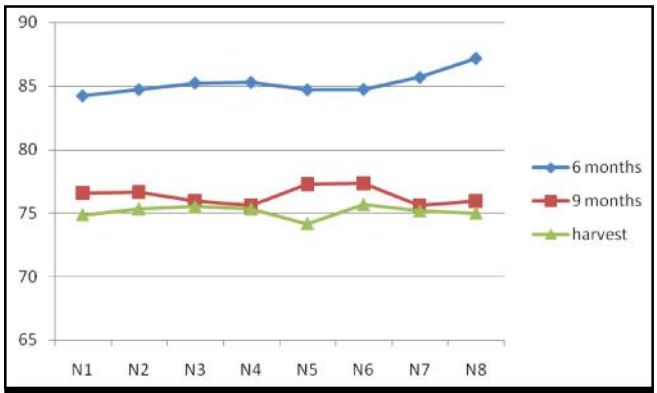

Fig. 1 : Mean sheath moisture at 6 months, 9 months and harvest in plant crop of sugarcane

The sheath moisture recorded during 6th month period was not significantly influenced by varieties or the nutrient management practices. However, Co 62175 variety registered numerically higher sheath moisture over Co 86032. The sheath moisture recorded during 9th month had shown a decline. At this stage Co 62175 showed significantly higher moisture (77.33%) compared to C0 86032. The sheath moisture for the nutrient management practices with organic sources recorded numerically lower values compared to integrated method. The sheath moisture at harvest showed further decline in values as it approached the harvest stage.

However, the values were not influenced significantly by the variety or combination of nutrient sources in any of the stages. Significantly higher leaf sheath moisture content was noticed in potash applied crop at the end of the formative and grand growth periods, which might be due to increased osmotic potential as a result of K absorption by the root cells. Potassium is known to help in regulating opening and closure of stomata leading to higher moisture retention in the tissues (Jamuna *et al.*, 1994 and Rajkumar and Kambar, 1999). Clements (1977) opined that tissue moisture content is the integrator of all the factors both internal and external, affecting the crop. The higher leaf sheath moisture per cent might be responsible for better uptake of nitrogen from the soil to enable favourable growth conditions resulting in higher yield. Patil (2008) has clearly demonstrated that the leaf sheath moisture decreased from 160 days after planting (DAP) to 240 DAP. The treatments differed significantly at both the stages. At 140 DAP, T_7 recorded significantly higher leaf sheath moisture content over all other treatments except T_1, T_4, T_5, T_6 and T_{11}. While, the treatments T_3, T_8, T_{12} and T_{13} were found to be at par with each other. At 240 DAP, the leaf sheath moisture content was significantly superior in T_1 over other treatments except T_3, T_5, T_7 and T_8.

Table 2 : SPAD chlorophyll meter reading at 6 months as influenced by nutrient management practices in plant crop of sugarcane

Nutrient management practices		Varieties		Mean
		V_1	V_2	
N_1	Pressmud + sunnhemp + biofertilizers	41.68	40.03	40.85
N_2	Pressmud + FYM + biofertilizers	41.90	39.41	40.65
N_3	Pressmud + FYM + French beans + biofertilizers	40.58	38.66	39.62
N_4	Pressmud + FYM + neem cake + biofertilizers	41.11	38.97	40.04
N_5	Pressmud + FYM + vermicompost + biofertilizers	41.32	38.99	40.16
N_6	50% N through pressmud + 50% NPK through fertilizers + biofertilizers	42.08	38.97	40.53
N_7	Recommended package of practices	42.53	40.09	41.31
N_8	100% NPK through fertilizers only	42.76	39.41	41.09
	Mean	41.74	39.32	40.53
		S.E.m ±		C.D. @ 5%
	Varieties (V)	0.087		0.532
	NMP (N)	0.660		1.912
	V × N	0.933		NS
	N × V	0.877		NS

V_1 – Co. 62175 V_2 – Co.86032

While, the rest of the treatments were at par with each other except T_2. The treatment T_2 had significantly lower leaf sheath moisture content over all other treatments. In the present investigation the leaf sheath moisture (LSM) content decreased with advancement in crop age. Among the treatments, stress treatment showed lower LSM and higher LSM was recorded with the foliar spray of urea (3%) + KCl (3%) followed by alachlor (200 ppm).

SPAD chlorophyll metre reading :

The SPAD values were influenced by variety and nutrient management practices at 6 months after planting of sugarcane. Significantly higher SPAD values were recorded with Co 62175 variety (41.74) over Co 86032 (39.32) indicating a better growth and active and healthy leaves of the variety.

Among the nutrient management practices, N7 (Recommended package of practices) recorded significantly higher SPAD values (41.31) over all the other treatments except N3. The nutrient management practices at harvest did not influence the SPAD values as the crop had approached the harvest and the leaves the senescence stage. (Table 2 and 3 and Fig. 2).

Yield of cane :

The sugarcane yield (Table 4) was significantly higher with Co 62175 variety (149.4 t/ha) compared to Co 86032 (130.05

Table 3: SPAD chlorophyll meter reading at harvest as influenced by nutrient management practices in plant crop of sugarcane

Nutrient management practices		Varieties		Mean
		V_1	V_2	
N_1	Pressmud + sunnhemp + biofertilizers	37.78	32.25	35.01
N_2	Pressmud + FYM + biofertilizers	39.76	33.85	36.80
N_3	Pressmud + FYM + French beans + biofertilizers	39.44	33.62	36.53
N_4	Pressmud + FYM + neem cake + biofertilizers	38.13	34.41	36.27
N_5	Pressmud + FYM + vermicompost + biofertilizers	37.25	33.14	35.19
N_6	50% N through pressmud + 50% NPK through fertilizers + biofertilizers	36.77	31.60	34.19
N_7	Recommended package of practices	38.99	33.44	36.21
N_8	100% NPK through fertilizers only	36.62	32.03	34.35
	Mean	38.10	33.04	35.57
		S.E.m±		C.D. (P=0.05)
	Varieties (V)	1.034		NS
	NMP (N)	1.394		NS
	V × N	1.971		NS
	N × V	2.114		NS

V_1 – Co. 62175 V_2 – Co.86032

Table 4 : Sugarcane yield (t ha^{-1}) as influenced by nutrient management practices in plant crop of sugarcane

Nutrient Management Practices (N)		Varieties		Mean
		V_1	V_2	
N_1	Pressmud + sunnhemp + biofertilizers	135.31	118.95	127.13
N_2	Pressmud + FYM + biofertilizers	133.83	118.52	126.17
N_3	Pressmud + FYM + French beans + biofertilizers	137.35	126.69	132.02
N_4	Pressmud + FYM + neem cake + biofertilizers	136.11	121.25	128.68
N_5	Pressmud + FYM + vermicompost + biofertilizers	135.99	119.69	127.84
N_6	50% N through pressmud + 50% NPK through fertilizer + biofertilizer	187.94	152.72	170.33
N_7	Recommended package of practices	191.65	157.99	174.82
N_8	100% NPK through fertilizers only	137.04	124.63	130.83
	Mean	149.40	130.05	–
		S.E.m ±		C.D. (P=0.05)
	Varieties (V)	0.94		2.73
	NMP (N)	1.73		5.02
	V × N	2.45		7.10
	N × V	2.48		7.18

V_1 = Co.62175 V_2 – Co.86032

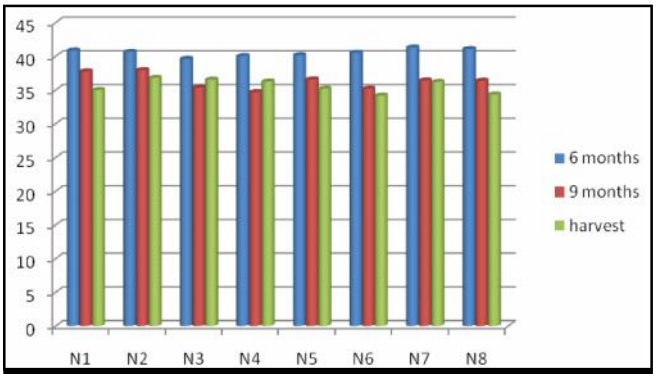

Fig. 2 : SPAD values at 6months, 9 months and at harvest in plant crop of sugarcane

t/ha). Obviously the sheath moisture was higher at 6 months in the former variety. (41.74) . The recommended package of practices (N7) has resulted in higher SPAD (41.31) and has resulted in higher yields (174.82 t/ha) indirectly indicating the relationship of higher sheath moisture at initial stages of crop growth and subsequent decrease at harvest and higher SPAD values recorded with higher yield of cane. Significantly higher leaf sheath moisture content was noticed in potash applied crop at the end of the formative and grand growth periods (Rajkumar and Kambar, 1999). The SPAD values are the indication of the overall health of the crop and sheath moisture in the initial phase of crop growth do reflect in the final yield of crop as per the outcome of the current investigation.

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