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Preliminary studies of hydrocyanic acid content in the fodder sorghum of the Madras State

by

K. MAHUDESWARAN Assistant in Millets
K. MEENAKSHI ,,
M. S. THANGAM ,,
T. RADAKRISHNAN Assistant in Chemistry
Agricultural College and Research Institute, Coimbatore

Introduction : Sorghum is not only a food crop but also a fodder crop in India. Its adaptability to droughty conditions and its high production of forage, has given it an important status in Agriculture of this country. A large percent of the cattle subsist on this forage and it is preferred to others because of its palatability and nutritive value. In such an important crop, the presence of hydrocyanic acid in lethal doses in its seedling stage has been a drawback. As the plants mature, the poison content decreases and it is a well known fact that even the green stalks can be fed to cattle after the flowering stage. The preliminary study presented in this paper is on hydrocyanic acid content of the five important fodder types of the Madras State at their growth period and has deduced the earliest safe stage when the plants can be cut and fed to cattle.

Previous work : The first instance of cattle poisoning by sorghum fodder was recorded in 1900. In the year 1902 the poison was traced as hydrocyanic acid (also known as prussic acid) (Dunstan and Henry — 1902). It is present as a glucoside called "Dhurrin" which on hydrolysis liberates hydrocyanic acid. Presence and the quantity of the glucoside vary with the age of the plants, conditions of growth and the variety. As the plants mature, the acid content becomes low (Laude and Swanson 1933). Acharya (1933) observed that during the early stages of growth there is 0·2% to 0·3% of hydrocyanic acid. Then it decreases gradually and at 0·02% it is considered harmless to animals. Leaves contain 60% of the total hydrocyanic acid in the whole plant structure, the upper leaves having a greater concentrate. The acid content is low in the morning, gradually increases up to 2 p. m., then falls in the evening and there is a rapid decline in the night. Young plants, ratoons, secondary shoots and side shoots are rich in hydrocyanic acid. Drying in the shade shows a decrease of ten percent acid content and sun drying decreases to 30—40 percent. The best method of lowering

the poison is silaging where it is considerably reduced. Boyd *et al* have found out (1938) that high nitrogen and low phosphorous of the soil, increase the acid content in the plants. Drought has an indirect effect to increase the poison. Regarding the relationship between irrigation and cyanogen content, Franzke *et al* (1939) have found that the crop grown under irrigated conditions has a lower hydrocyanic acid as compared to crop raised under rainfed conditions. Vinall (1921) has found that hydrocyanic acid content has been found to increase with the incidence of insects and sorghum plants attacked by aphid were found to have double the quantity of the glucoside. The high and low content of the acid have been found to be basically controlled by heritable factors in wild sorghum (S. sudanense). The sweet Amber sorgho has been found to have very low hydrocyanic acid content and the low acid content is partly dominant to high content of acid (Franzke *et al* 1939). The wild sorghum, *Sorghum verticilliflorum* has been reported to be dangerous to stock throughout the period because of the high hydrocyanic acid content (Winks 1940).

Materials and Methods: The materials experimented upon belong to five special fodder types of the Madras State and their discriptions are given below :

1. *Cholam strain Co. 11 :* This is a short duration Patcha Jonna from Nandyal, Andhra State, belonging to *Sorghum durra* var. *mediocre* (Snowden 1936). The duration of this strain, seed to seed, is 115 days. It is grown both under monsoon and summer seasons. Under irrigated conditions a tonnage of 20,000 lbs. of green fodder per acre is obtained. The stalks are sweet and juicy and grow to a height of 6 feet.

2. *Cholam strain Co. 10 :* Cholam Co. 10 is a mutant for its long duration from strain Co. 11 (Ayyangar *et al* 1037). Its duration is 160 days and this also belongs to *Sorghum durra* var. *mediocre* (Snowden 1936). The best sowing time is June - August and its green straw yield is 60,000 lbs. per acre. Stalks are sweet and juicy and the crop attains a height of 8 to 10 feet.

3. *Cholam strain K. 1 :* This is a pure line selection of the Irungu Cholam, *Sorghum dochna* var. *irungu* (Snowden 1936) of Tirunelveli district where it is grown purely for fodder. It has a duration of 125 days and is always sown in the months of August - September as a rainfed crop. The stalks attain a height of 6 feet and green fodder of 15000 lbs., per acre is obtained. The stalks are thin, pithy and sweet.

4. *Cholam strain K. 3 :* It is an improvement over Cholam K. 1 and is an extracted type evolved by crossing Irungu Cholam *(Sorghum dochna)* with Periamanjal Cholam *(Sorghum durra)* of Coimbatore and is a grain cum fodder strain, and is popularly termed as Perimanjal Irungu. From its botanical characters it has been fixed as *Sorghum dochna*. It has the same duration of K. 1 but gives an acre yield of 20,000 lbs. of green fodder per acre. Plants grow to a height of 6 to 8 feet and its stalks are pithy and sweet (Ponnaiya and Anavardham - 1933).

5. *Sclection A. S. 8208 :* This selection has been received from China and has been classified as *Sorghum nitens*. The duration is 100 days and is a tillering type having 4 to 5 tillers. Plants attain a height of 6 feet and come up throughout the year and yield 10,000 lbs. of green fodder. The stalks are thin and pithy (Snowden, 1936).

These strains were sown in the month of August in plots of one cent each. The plots receiving compost manure at 10 tons per acre and the soil is red sandy loam. The seeds were sown in rows 2 links apart at the rate of 30 lbs. per acre and all the agricultural operations were given uniformly to all the five plots. The first samples were gathered when the plants were 30 days old. Thereafter samples were collected at every ten days interval until the plants completed flowering. Plants were selected at random and cut at 1 inch above the ground level.

Estimation of hydrocyanic acid content : Random samples of ten plants were collected, finely chopped and mixed thoroughly. From the well mixed sample, about 100 grams of plant tissue were taken and the hydrocyanic acid was estimated by the method given by Acharya (1933).

Experiment Results : The stages at which the plants were analysed, the hydrocyanic acid content and the duration of the individual strains are presented below :

Discussion : The results corroborate the previous works and there is ample evidence to prove that young cholam seedlings below 50 days old contain a high content of hydrocyanic acid and it decreases from the early stages progressively till the plants attain the boot stage. The safe stage for feeding is below 0·02% level (Acharya, 1933) and the short duration strains Co. 11, K. 1 and K. 3 are free from lethal doses of hydrocyanic acid content after 60 days

Particulars	Age of the crop analysed and the percentage of hydrocyanic acid content						Average height in feet of full grown crop	Duration of the crop (seed to seed in days)	Green straw yield per acre in lb.	Safe period to feed from the time of sowing
	days 30	days 40	days 50	days 60	days 70	days 80				
1. Strain Co. 11	0·0883	0·1017	0·0229	**0·0100**	0·0105	0·0033	6	115	20,000	60 days
2. Strain Co. 10	0·2397	0·1114	0·0354	0·0254	0·0240	**0·0074**	8 to 10	160	60,000	80 days
3. Strain K. 1	0·1422	0·0523	0·0271	**0·0151**	0·0053	0·0043	6	125	15,000	60 days
4. Strain K. 3	0·0832	0·0623	**0·0184**	0·0086	0·0060	0·0015	6 to 8	125	20,000	50 days
5. Selection A. S. 8208	0·2396	0·1483	0·0326	**0·0144**	0·0068	0·0022	6	100	10,000	60 days

Note : 0·020% of hydrocyanic acid is considered to be harmless to animals.

of growth while the long duration strain Co. 10 is poisonous to cattle till 80 days of growth. Though selection A. S. 8208 has a very short duration of 100 days it is found poisonous till it is 60 days old presumably due to its tillering habit. This is in line with Martins observation (1933) viz., side tillers and axillary branches contain a high percentage of the acid, as compared to main shoots.

Summary: A preliminary study was conducted to find out the earliest safe period when it can be cut and fed to cattle. Five fodder types belonging to Sorghum species of the Madras State were analysed for hydrocyanic acid content during their growth period at ten days interval. Long duration strain of 160 days was found to be free from lethal dose of hydrocyanic acid when 80 days old whereas strains having 125 days can be cut earlier viz., 60 days after sowing. In the case of tillering variety although the duration is only 100 days it was found to be safe for feeding only after 60 days of growth.

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CAN THE EARTH FEED MANKIND

Irrefutable Facts

The land surface of the earth amounts to 149 million square kilometres. No more than 1,000 Million hectares (1 hectare equals 2·47 acres) are farmed today. And yet, the Soviet soil scientist and geographer Academician L. I. Prasolov estimates that only 11 per cent of the earth's surface could be considered entirely unpopulated today (the Arctic and the Antartic), and some 19 per cent is made up of deserts. The remaining includes 10·1 per cent of fertile valleys, 38·4 per cent of transitional soils (forest and dry steppe), 13·7 per cent of mountain pastures and forests. Half the desert areas (which comprise 19 per cent) could be reclaimed for agriculture with the aid of irrigation. It follows that more than two-thirds or over 10,000 million hectares of land may be considered suitable for farming and life.

Should this land be developed, with the proper relationships between the crops, the annual production of animal and field husbandary would be adequate to feed at least 25,000 million people a year, i. e., almost ten times greater than the existing population of the earth.

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