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Biological parameter and quality factor (ADF, NDF) of hydroponics under the influence of foliar spray

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Abstract
In these experiment, we aim to find out the biological parameter of the six crops taken *viz.* pearl millet (*Pennisetum purpureum*), yellow maize (*Zea mays*), Oat (*Avena sativa*), Barley (*Hordeum vulgare*), wheat (*Triticum aestivum*) and white maize (*Zea mays*) which were grown hydroponically to produce fodder and also some quality parameters like ADF and NDF. The research which was conducted in the April-May, 2016 in PGI farm of Mahatma Phule Krishi Vidyapeeth, Rahuri used a rack of 2.7 m x 1.5 m area. This rack was made of UV-PVC polypipe which held 54 trays of size 50 cm x 30 cm x 5 cm. factorial complete randomized design were the experimental design used. Foliar spray was done on 5th day to all the crops taking two different water soluble fertilizers urea @ 0.5 % and 19-19-19 @ 0.5 % and one was kept as control (no foliar spray) in each crop. So, all together the treatment combinations were eighteen. Water to the system was supplied by micro sprinkler/ jet irrigation applied at every regular intervals of 3 hours in all crops except pearl millet which needed only once in 4 hours. Better growth was recorded in foliar applied treatments than the control in all the crops taken. The plant height and root length growth was steady. The plant height and root length was highest in maize crops both yellow and white maize. In each crops taken 19-19-19 WSF sprayed treatment, the quality though was different from crop to crop on considering the best among all pearl millet and wheat showed better content than other crops. The ADF and NDF content were varied even among the same crop treatments which may be due to difference in foliar treatment. 19-19-19 WSF @ 0.5 % sprayed treatments had lowest ADF and NDF content and so possess better quality. Results show foliar spray of 19-19-19 WSF most successful in respect of growth performance and ADF/ NDF content in all the six crops.

Keywords: hydroponic fodder crops, micro sprinkler irrigation, water soluble fertilizer, acid detergent fibre, neutral detergent fibre

Introduction
Hydroponic methods have been used for a long time to grow plants, primarily vegetables, but hydroponics is now being used across many countries to take pressure off the land and grow green feed for livestock, birds and carp raised for agriculture.
Calder Bill (2002) [2] has shown that the growing time of hydroponic plants takes as little as 7 days from seed germination to a fully grown plant as at a height of 25-30cm ready for harvest.
Scott (2002) [8] reported that in 24 hours seeds sprout a root, green shoots day 2 and 3, by 5 days you can early harvest, 7 days is about maximum before they slow down and behave more like slow growing grasses.
Sprouting is a simple technique to germinate the seeds for the improvement of their nutritive value (Amal *et al*., 2007) [1]. Supplementation of hydroponics sprouts in the rations of dairy animals is coming up as a viable alternate technology for the livestock farmers due to lesser availability of green fodders (Naik and Singh, 2014; Naik *et al.*, 2015; Naik *et al*., 2016) [5-7]. During sprouting, the activities of the inactive enzymes of the grains increased which ultimately break down the reserve chemical constituents that could be used for synthesis of new 23 compounds while breaking down undesirable constituents (Chavan and Kadam, 1989) [3] thus leading to increase in the quality of the amino acids and concentrations of the vitamins (Koehler *et al*., 2007) [4].

Materials and Method
Standardization of seed rate of different hydroponic crops per tray (size: 50 cm x 30 cm x 5 cm)

Table 1

Sr. No.	Crop	Seed rate(g tray^{-1})
1.	Pearl millet	700
2.	Yellow maize	1100
3.	Oat	600
4.	Barley	600
5.	Wheat	800
6.	White maize	1200

Soaking of seeds and the rapid uptake of water for facilitating the metabolism and utilization of reserve materials of the seeds for growth and development of the plant is very important step for the production of hydroponic forage. Number of hours of soaking for all crops was 6hr. The water was then drained and the seeds packed or wrap in wet gunny bags and kept for few more hours. It varies with different crop. Pearl millet and wheat was kept wrapped in gunny bag for 7hr. In yellow maize and white maize it was kept for 14 hours while in oat and barley for 6hr. Water was sprinkled in the gunny bags from time to time making sure it is always kept wet. The germinated seeds were then transferred in the trays. The seed rate were fixed. The seeds were filled in the trays to the level of the ridges and were soaked separately for each tray. When the absorbed water and bulged out they a

slightly above the ridges and become the perfect seed layer for growth. When the seeds were too low they do not grow well and when there were too much seed they began to show root rotting symptoms, mould growth etc. before reaching the targeted harvesting day.

The seeds were kept in the tray and water was sprinkled on tray at an interval of 3hr till the third day. And from 4th day onwards water was supplied at an interval of 2 hr during day time (1min irrigation after every 2hr) and after 6 PM till early morning 6AM, water was sprinkled on tray at an interval of 4hr. On the 5th day from early morning the automatic system was switch off. Water mixed with urea @ 0.5% was foliar sprayed with the help of hand sprayer and water mixed with 19-19-19 starter grade of water soluble fertilizer @ 0.5% was sprayed. As control three trays of each crop was sprayed with tap water only. Water or the mixer was foliar sprayed at every 3 hr interval 3 times and after the last spray automatic system of irrigation was activated again. In treatment, Factor A was the hydroponic crops in which C_1- Pearl millet, C_2- Maize, C_3- Oat, C_4- Barley, C_5- Wheat and C_6 - White maize while Factor B were foliar spray of water soluble fertilizers viz. F_1- No foliar application, F_2 - Foliar spray of N-Urea 0.5% spray and F_3 - Foliar spray of NPK-19:19:19 WSF spray at 0.5%.

Five plants on easy to remove site usually on the outer side were selected and tagged in each replication of all the treatment combination. Plant height, number of leaves, stem diameter, root and shoot length (to find the root; shoot ratio) were taken from 3rd day onward till 10th day. To measure plant height, a measuring scale with clear markings (in centimeter as well as in millimeter) were used. While for stem diameter, thread were used and then the values were recorded by measuring the length of the thread which was wrapped around the plant making sure that the end points of the thread touch each other completing a single round. For root length also, thread were used. The thread was placed over the root perfectly matching the curves and turns and later measured the length of the thread used to match the root through a measuring scale. Visual countings were followed to count number of leaves.

Results

Table 2: Biological parameters recorded on 10th day as influenced by foliar spray

Treatment combination		Plant Height (cm)	Root Length (mm)	No. of Leaves	Stem Diameter (mm)
C_1F_1:	Pearlmillet + Control	9.6	31	2	10
C_1F_2:	Pearlmillet + Urea foliar spray @ 0.5 %	11.4	34	2	10
C_1F_3:	Pearlmillet + 19-19-19 WSF spray @ 0.5 %	10.6	32	2	10
C_2F_1:	Yellow maize + Control	24.5	102	3	25
C_2F_2:	Yellow Maize + Urea foliar spray @ 0.5 %	26.6	112	3	30
C_2F_3:	Yellow Maize + 19-19-19 WSF spray @ 0.5 %	26.9	113	3	30
C_3F_1:	Oat + Control	13.9	60	2	10
C_3F_2:	Oat + Urea foliar spray @ 0.5 %	16.7	75	2	15
C_3F_3:	Oat + 19-19-19 WSF spray @ 0.5 %	17.0	75	2	15
C_4F_1:	Barley + Control	15.8	49	2	15
C_4F_2:	Barley + Urea foliar spray @ 0.5 %	18.1	55	2	20
C_4F_3:	Barley +19-19-19 WSF spray @ 0.5 %	18.3	55	2	20
C_5F_1:	Wheat + Control	15.6	36	2	10
C_5F_2:	Wheat + Urea foliar spray @ 0.5 %	19.8	43	2	15
C_5F_3:	Wheat + 19-19-19 WSF spray @ 0.5 %	20.2	42	2	15
C_6F_1:	White Maize + Control	24.7	108	3	25
C_6F_2:	White Maize + Urea foliar spray @ 0.5 %	25.5	114	3	25
C_6F_3:	White Maize + 19-19-19 WSF spray @ 0.5 %	25.7	115	3	30
	S.Em.±	0.12	0.91	-	21.59
	CD at 5%	0.35	2.63	-	NS
	Mean	18.96	69.83	-	22.731

As per expected seeing the growth data, yellow maize 19-19-19 WSF treated attained maximum height of 26.9 cm which was at par with urea treated yellow maize. The successful crop next to it based on plant height is white maize. The height of pearl millet even in treated ones was still less (9.4 cm in urea treated and 9.2 cm in 19-19-19 WSF treated). The height attained by barley was not satisfying in comparison with the results provided by Snow *et al* (2008) [9] conducted in temperate regions of Canada which claimed that it reached 22 cm at 10th day. Whereas in our indian situation of may month, it reached only 18.3cm that too in 19-19-19 WSF treated barley which was considered better than urea treated barley (18.1 cm).

We can observed the influence of foliar spray on growth of root and both the foliar treatment i.e. urea @0.5% and 19-19-19 WSF @0.5% were equally effective.

Foliar spray seemed not to play any role in increasing no. of leaves as it remained same in all the foliar spray treatment in different crops. Different crops had different no. of leaves. But in most crops 2 leaves in each plant was common. In yellow maize and white maize, the average number of leaves was three in both the crops. Here crop type counted and in that case both yellow maize and white maize were best with maximum number of leaves.

The plant diameter in pearl millet was almost same even in all the foliar sprayed treatments too. So, foliar spray had no

influenced on increasing the plant diameter.

In yellow maize there was a slight difference in plant diameter between foliar sprayed treatments and no foliar spray treatment but the diameter was same in both urea @0.5% foliar spray treatment and 19-19-19 WSF @0.5% foliar spray treatment.

The plant diameter of oat was disproportionate compared to plant height so, there was a problem of lodging. The problem of lodging was lesser in case of foliar treatments as the plant diameter was higher than no foliar sprayed treatment. In both urea treated and 19-19-19 WSF treated oat, there was equal plant diameter and the type of fertilizer did not seem to affect much to this parameter.

In barley and wheat, effectiveness of foliar treatment was observed but the type fertilizer sprayed did not bother the increased in plant diameter. In white maize maximum plant diameter was observed in 19-19-19 WSF treated one so in this case it was better than that of urea treated white maize.

Table 3: Quality Factors of Hydroponic Fodder Crop recorded on 10th day as influenced by foliar spray

	Treatment combination	At harvest (10TH DAY)	
		ADF content (%)	NDF content (%)
C_1F_1:	Pearl millet + control	14.03	31.77
C_1F_2:	Pearl millet + urea foliar spray @ 0.5 %	15.14	32.66
C_1F_3:	Pearl millet +19-19-19 WSF Spray @ 0.5 %	15.25	32.13
C_2F_1:	Yellow maize + control	18.33	32.56
C_2F_2:	Yellow maize + urea foliar spray @ 0.5 %	19.12	34.18
C_2F_3:	Yellow maize +19-19-19 WSF Spray @ 0.5 %	19.56	35.27
C_3F_1:	Oat + control	20.31	37.23
C_3F_2:	Oat + Urea foliar spray @ 0.5 %	21.30	38.15
C_3F_3:	Oat + 19-19-19 WSF Spray @ 0.5 %	23.14	37.21
C_4F_1:	Barley + control	14.01	33.63
C_4F_2:	Barley + Urea foliar spray @ 0.5 %	15.09	33.65
C_4F_3:	Barley +19-19-19 WSF Spray @ 0.5 %	15.34	34.24
C_5F_1:	Wheat + control	19.20	30.57
C_5F_2:	Wheat + Urea foliar spray @ 0.5 %	19.40	31.49
C_5F_3:	Wheat + 19-19-19 WSF Spray @ 0.5 %	19.15	31.11
C_6F_1:	White maize + control	20.62	33.70
C_6F_2:	White maize + Urea foliar spray @ 0.5 %	21.60	35.57
C_6F_3:	White maize + 19-19-19 WSF Spray @ 0.5 %	20.21	35.72
	S.Em.±	0.221	0.22
	CD at 5%	0.633	0.63
	Mean	21.301	21.30

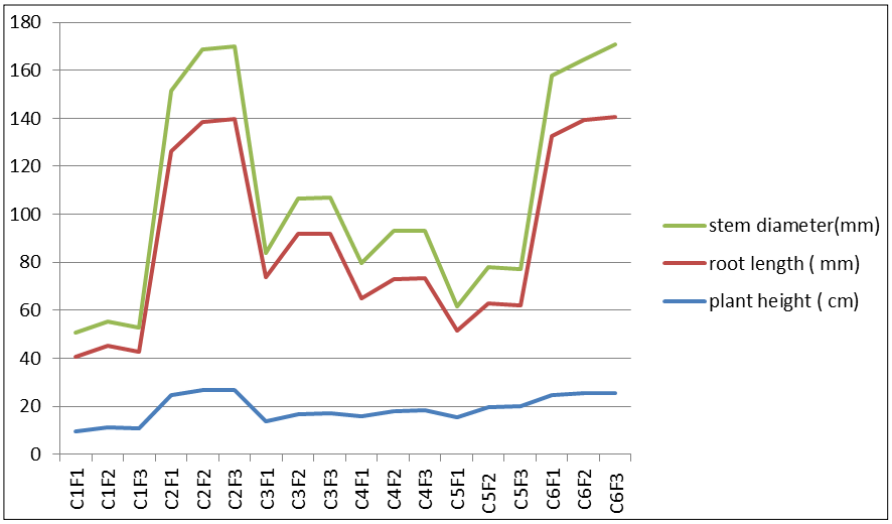

Fig 1: graphical presentation of stem diameter, root length and plant height of treatment combinations as influenced by foliar spray.

Maximum ADF content was noticed in 19-19-19 WSF treated oat (23.14 %) and are superior than other treatments. Urea treated pearl millet, urea treated yellow maize, 19-19-19 WSF treated yellow maize, control of oat, control of yellow maize, control of wheat, urea treated wheat, 19-19-19 WSF treated wheat all were at par. The lowest ADF in per cent was discovered in control of pearl millet but among the foliar applied treatments, urea treated barley had lowest content (15.09 %)

Control of wheat (30.57%) where no foliar spray was done content lowest NDF of all treatments. 19-19-19 WSF treated wheat (31.11%), urea treated wheat(31.49 %) and control of

pearl millet (31.77 %) were at par. Highest NDF content was observed in urea treated oat (38.15 %). Among high NDF containing treatments, control of oat (37.23 %) and 19-19-19 WSF (37.21 %) was also included. In pearl millet, oat and wheat the NDF value were higher in urea treated than 19-19-19 foliar sprayed treatments. While in yellow maize, barley and white maize the 19-19-19 WSF treatments had higher NDF content than urea treatments.

Conclusions

Plants which were foliar sprayed had a much healthier growth with more plant growth and larger diameter as compared to no foliar sprayed treatments. The nutrient content or crop quality was improved by applying foliar spray and better result was found in pearl millet with 19-19-19 WSF foliar spray treatment combination. Yellow maize sprayed with 19-19-19 WSF had low ADF and NDF. ADF and NDF below 35% and 50 % respectively are considered as good fodder. All crops taken were in desirable ranges and hence are high quality fodders.

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