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## Effect of foliar application of nutrients on growth and yield of Horsegram [*Macrotyloma uniflorum* (Lam.) Verdc.]

**Mukesh, JR Patel, HP Agrawal, PK Keshary, AP Agrawal, NK Chaure, Chanchala Rani Patel, Mahendra Kumar Patel, Digambar Sakre and Shreya Kumbhaj**

### Abstract

An experiment was conducted at Instructional Farm, Barrister Thakur Chhedilal College of Agriculture and Research Station, Bilaspur (C.G.) during *kharif* season of 2022 to study the effect of foliar application of nutrients on growth and yield of Horsegram [*Macrotyloma uniflorum* (Lam.) Verdc.]. The result revealed that treatment T<sub>7</sub> (RDN + 2% NPK 19:19:19 spray) recorded significantly higher growth parameters *viz.*, plant height, number of branches plant<sup>-1</sup>, number of leaves plant<sup>-1</sup>, dry matter accumulation (g plant<sup>-1</sup>), number of root nodule plant<sup>-1</sup> and nodule dry weight (mg plant<sup>-1</sup>) and yield attributes *viz.*, number of pods plant<sup>-1</sup>, number of seeds pod<sup>-1</sup>, pod length (cm), test weight (g), grain yield as well as stover yield and biological yield of Horsegram, but at par with T<sub>5</sub> (RDN + 2% DAP spray). All foliar application treatments and RDN shows superiority over control (T<sub>1</sub>). Treatment T<sub>1</sub> (control) shows significantly lowest value of these parameters.

**Keywords:** Horsegram, foliar application, NPK (19:19:19) and DAP

### Introduction

Horsegram [*Macrotyloma uniflorum* (Lam.) Verdc.] is a pulse, often known as kulthi as well as poor man's pulse crop. Crop is belonging to the family Fabaceae which is still an under exploited legume crop. It is also known as Kulattha (Sanskrit), Kurti-kalai (Bengali), Kollu (Tamil), Ullavallu (Telugu), Muthira (Malyalam) and Gahot (Kumaon and Garhwal). According to Bravo *et al.* (1999) [14] Horsegram contains protein (25%), carbohydrates (60%) and essential amino acids, energy, fat, iron and molybdenum. It is one of the inexpensive sources of protein, calcium and iron. Horsegram is widely grown in India in almost 200-700 mm rainfall situations at a temperature range of 20-35 °C so called drought tolerance crop. Horsegram is typically adapted to a wide range of soils as deep red, loams, black cotton soils, clayey paddy soils, sandy and shallow soils, stony and gravelly uplands, cleaned rough forests etc. It is grown as a sole crop and in a number of combinations. Due to wide adaptation in terms of soil and climatic situations, Horsegram is grown in almost all states of India but its 90-95 percent area is confined to five major states Orissa (16.0%), Tamil Nadu (18.0%), Karnataka, (34.0%), Maharashtra (18.0%) and Andhra Pradesh (16.0%).

Horsegram was grown in area of 0.458 million hectares in India during 2019–2020, with a production of 0.297 million tonnes and a productivity of 6.48 q ha<sup>-1</sup> (Anonymous, 2021) [2]. In Chhattisgarh, the area, production and productivity of Horsegram was 0.026 million ha, 0.010 million tonnes and 3.90 q ha<sup>-1</sup>, respectively (Anonymous, 2019) [1]. On the basis of area Kondagaon is the largest followed by Jashpur, Kanker and Korba in Chhattisgarh. However, it is often grown in upland soils with minimal maintenance. It is generally grown in Northern hill zone and Baster plateau of Chhattisgarh which are dominated by tribal farmers.

Foliar application is credited with the advantage of quick and efficient utilization of nutrients, elimination of losses through leaching, fixation and regulating the uptake of nutrients by plant (Manonmani and Srimathi, 2009) [11]. The poor production potential of pulses is attributed to poor photosynthate of pods and seed setting, which may be improved through foliar application of macronutrient and plant growth regulators (Meena *et al.*, 2017) [12]. Foliar application of N at particular stage may solve the slow growth, nodule senescence and low seed yield of pulse without involving root absorption at critical stage (Kumar *et al.*, 2019) [9].

Foliar application of nutrient and growth regulator at pre flowering and flowering stage was seen on reduction in flowering drop percentage in blackgram (Beulah and Ghosh, 2020) [3]. Keeping these points in view, a field experiment was conducted to assess the Effect of foliar application of nutrients on growth and yield of Horsegram [*Macrotyloma uniflorum* (Lam.) Verdc.].

## Materials and Methods

An experiment was conducted at Instructional Farm, Barrister Thakur Chhedilal College of Agriculture and Research Station, Bilaspur (C.G.) during *kharif* season of 2022. The investigation was carried out in a randomized block design (RBD) where in nine treatment combinations in three replications *i.e.* T<sub>1</sub> - Control; T<sub>2</sub> - RDN (20, 40 and 10 kg of N, P<sub>2</sub>O<sub>5</sub> and K<sub>2</sub>O ha<sup>-1</sup>, respectively); T<sub>3</sub> - RDN + 2% Urea spray at 25 DAS; T<sub>4</sub> - RDN + 2% SSP spray at 25 DAS; T<sub>5</sub> - RDN + 2% DAP spray at 25 DAS; T<sub>6</sub> - RDN + 2% MOP spray at 25 DAS; T<sub>7</sub> - RDN + 2% NPK (19:19:19) spray at 25 DAS; T<sub>8</sub> - RDN + 250 ppm Cycocel (CCC) spray at 25 DAS and T<sub>9</sub> - RDN + Water spray at 25 DAS were chosen for study purpose. The soil of the experimental plot was sandy clay loam in texture, neutral in reaction, medium in organic carbon, low in available nitrogen, medium in available phosphorus and high in available potassium content. The weather condition during crop season was favourable for normal growth and development of Horsegram. The Horsegram variety Alakh Kulthi was sown on 28 September 2022 and harvested on 22 January 2023.

## Results and Discussion

### Pre-harvest observation

**Plant height (cm):** In various foliar application practices, at 25 DAS all foliar application treatments and RDN shows significantly superiority over control at 25, 50, 75 DAS and at harvest. At 50 DAS the significantly highest plant height (46.96 cm) was recorded under T<sub>7</sub> RDN + 2% NPK (19:19:19) spray which was at par with the T<sub>5</sub> RDN + 2% DAP spray. While the lowest plant height (28.13) recorded in T<sub>1</sub> control. Similar trend was also found at 75 DAS and at harvest stage of crop. This result was confirmative with Jadhav *et al.* (2017) [6], Mandre *et al.* (2020) [10], Deore *et al.* (2021) [4] and Jaybhaye *et al.* (2022) [7].

### Number of primary branches plant<sup>-1</sup>

The number of branches significantly affected due to various treatments at 25, 50, 75 DAS and at harvest. At 25 DAS all

foliar application treatments and RDN shows significantly superiority over control. At 50 DAS significantly maximum number of primary branches (5.95) was noted with treatment T<sub>7</sub> RDN + 2% NPK (19:19:19) spray which was at par with the T<sub>5</sub> RDN + 2% DAP spray. While the lowest number of primary branches (3.10) recorded in T<sub>1</sub> control. Similar trend was also found at 75 DAS and at harvest stage of crop. This result was confirmative with Jadhav *et al.* (2017) [6], Mandre *et al.* (2020) [10] and Jaybhaye *et al.* (2022) [7].

**Number of leaves plant<sup>-1</sup>:** The number of leaves significantly affected due to various treatments at 25, 50, 75 DAS and at harvest. At 25 DAS all foliar application treatments and RDN shows significantly superiority over control. At 50 DAS significantly maximum number of leaves (20.80) was noted with treatment T<sub>7</sub> RDN + 2% NPK (19:19:19) spray at which was at par with the T<sub>5</sub> RDN + 2% DAP spray. While the lowest number of leaves (11.44) recorded in T<sub>1</sub> control. Similar trend was also found at 75 DAS and at harvest stage of crop.

### Dry matter accumulation (g plant<sup>-1</sup>)

As regards the dry matter accumulation significantly affected due to different treatments at 25, 50, 75 DAS and at harvest. At 25 DAS all foliar application treatments and RDN shows significantly superiority over control. At 50 DAS significantly maximum dry matter accumulation (5.84 g) was noted with treatment T<sub>7</sub> RDN + 2% NPK (19:19:19) spray at various crop growth stages, which was at par with treatment T<sub>5</sub> RDN + 2% DAP spray. While the lowest dry matter accumulation (3.54 g) recorded in T<sub>1</sub> control. Similar trend was also found at 75 DAS and at harvest stage of crop.

The increase in dry matter accumulation of horsegram was in treatment T<sub>7</sub> - RDN + 2% NPK (19:19:19) spray may be due to increase in growth parameters *viz.*, plant height, number of branches and number of leaves etc. under this treatment. This result was confirmative with Deore *et al.* (2021) [4].

### Number of root nodule plant<sup>-1</sup>

Number of root nodules was significantly affected at 50 and 75 DAS due to various treatment at 25, 50, 75 DAS. At 25 DAS all foliar application treatments and RDN shows significantly superiority over control. At 50 DAS significantly maximum number of root nodules (19.17) at 50 DAS was recorded under T<sub>7</sub> RDN + 2% NPK (19:19:19) spray which was at par with treatment T<sub>5</sub> RDN + 2% DAP spray. While the lowest number of root nodules (16.45) recorded in T<sub>1</sub> control. Similar trend was also found at 75 DAS of crop.

**Table 1:** Effect of foliar application of nutrients on plant height, number of branches and number of leaves of Horsegram

Treatment	Plant height (cm)				Number of branches plant <sup>-1</sup>				Number of leaves plant <sup>-1</sup>			
	25 DAS	50 DAS	75 DAS	At harvest	25 DAS	50 DAS	75 DAS	At harvest	25 DAS	50 DAS	75 DAS	At harvest
T <sub>1</sub> Control	12.23	28.13	40.06	37.66	1.76	3.10	4.10	4.19	6.13	11.44	29.20	14.96
T <sub>2</sub> RDN	16.23	33.60	47.76	45.56	2.46	3.93	5.16	5.25	7.53	14.33	36.06	18.33
T <sub>3</sub> RDN + 2% Urea spray	16.26	41.03	57.06	55.16	2.46	5.06	6.76	6.88	7.66	17.96	44.96	22.46
T <sub>4</sub> RDN + 2% SSP spray	17.43	40.53	56.73	54.76	2.73	4.96	6.64	6.73	8.06	17.76	44.40	22.26
T <sub>5</sub> RDN + 2% DAP spray	17.21	46.56	64.82	63.09	2.71	5.86	7.86	7.93	8.03	20.66	51.86	25.81
T <sub>6</sub> RDN + 2% MOP spray	16.96	39.99	56.36	54.36	2.66	4.89	6.49	6.58	7.83	17.46	43.70	21.96
T <sub>7</sub> RDN + 2% NPK (19:19:19) spray	16.83	46.96	65.23	63.58	2.53	5.95	7.99	8.06	7.73	20.80	52.26	26.06
T <sub>8</sub> RDN + 250 ppm Cycocel (CCC) spray	15.93	39.56	55.96	53.96	2.43	4.80	6.34	6.42	7.50	17.26	43.33	21.79
T <sub>9</sub> RDN + Water spray	15.43	33.90	48.20	46.00	2.43	4.00	5.33	5.38	7.46	14.40	36.96	18.43
S.Em ±	0.94	1.82	2.57	2.54	0.14	0.25	0.33	0.34	0.35	0.89	2.22	1.11
CD (P=0.05)	2.82	5.46	7.69	7.62	0.42	0.75	0.99	1.02	1.06	2.67	6.65	3.33

**Table 2:** Effect of foliar application of nutrients on dry matter accumulation, number of root nodule and Root nodule dry weight of Horsegram

Treatment	Dry matter accumulation (g plant <sup>-1</sup> )				Number of root nodule plant <sup>-1</sup>			Root nodule dry weight (mg)		
	25 DAS	50 DAS	75 DAS	At harvest	25 DAS	50 DAS	75 DAS	25 DAS	50 DAS	75 DAS
T <sub>1</sub> Control	0.360	3.54	5.28	5.77	4.82	10.48	9.68	3.92	10.42	9.22
T <sub>2</sub> RDN	0.444	4.23	6.37	7.03	5.76	12.90	11.95	4.93	13.31	12.60
T <sub>3</sub> RDN + 2% Urea spray	0.452	5.10	7.74	8.55	5.80	16.45	15.56	4.96	17.52	16.81
T <sub>4</sub> RDN + 2% SSP spray	0.480	5.05	7.67	8.47	6.14	16.24	15.15	5.14	17.21	16.51
T <sub>5</sub> RDN + 2% DAP spray	0.470	5.79	8.83	9.82	6.04	18.83	17.62	5.04	20.37	19.77
T <sub>6</sub> RDN + 2% MOP spray	0.460	5.01	7.61	8.41	5.86	15.97	14.83	5.04	16.9	16.20
T <sub>7</sub> RDN + 2% NPK (19:19:19) spray	0.454	5.84	8.92	9.98	5.84	19.17	18.04	5.03	20.68	19.98
T <sub>8</sub> RDN + 250 ppm Cycocel (CCC) spray	0.442	4.97	7.54	8.29	5.69	15.66	14.38	4.85	16.64	16.02
T <sub>9</sub> RDN + Water spray	0.430	4.28	6.45	7.09	5.63	13.27	12.24	4.80	13.73	13.03
S.Em ±	0.02	0.23	0.35	0.38	0.23	0.76	0.67	0.22	0.83	0.80
CD (P=0.05)	0.06	0.68	1.05	1.15	0.70	2.27	2.01	0.67	2.50	2.40

### Nodule dry weight (mg plant<sup>-1</sup>)

Nodules dry weight at 25 DAS all foliar application treatments and RDN shows significantly superiority over control. Nodules dry weight the significantly maximum (20.68 mg) at 50 DAS was recorded under T<sub>7</sub> RDN + 2% NPK (19:19:19) spray at 50 and 75 DAS which was at par with treatment T<sub>5</sub> RDN + 2% DAP spray. While the lowest nodules dry weight (10.42 mg) recorded in T<sub>1</sub> control. Similar trend was also found at 75 DAS of crop.

### Growth analysis

**Leaf area index:** The highest leaf area index of Horsegram (0.762) was recorded at 50 DAS with the T<sub>7</sub> - RDN + 2% NPK (19:19:19) spray which was at par with T<sub>5</sub> - RDN + 2% DAP spray and recorded significantly higher leaf area index as compared to all others. While significantly the lowest leaf area index (0.420) recorded in T<sub>1</sub> control. Similar trend was

also found at 75 DAS and at harvest stage of crop

### Crop growth rate (g day<sup>-1</sup> plant<sup>-1</sup>)

Between 25-50 DAS maximum CGR (0.215 g day<sup>-1</sup> plant<sup>-1</sup>) recorded with T<sub>7</sub> - RDN + 2% NPK (19:19:19) spray followed by treatment T<sub>5</sub> - RDN + 2% DAP spray. However, minimum CGR (0.127 g day<sup>-1</sup> plant<sup>-1</sup>) was observed in treatment T<sub>1</sub> - control. Similar trend was also found between 50-75 DAS and 75 DAS - at harvest stage of crop.

### Relative growth rate (g g<sup>-1</sup> day<sup>-1</sup>)

The maximum RGR (0.102 g g<sup>-1</sup> day<sup>-1</sup>) between 25-50 DAS recorded with T<sub>7</sub> RDN + 2% NPK (19:19:19) spray followed by treatment T<sub>5</sub> - RDN + 2% DAP spray. However, minimum RGR (0.0914 g g<sup>-1</sup> day<sup>-1</sup>) was observed in treatment T<sub>1</sub> - Control. Similar trend was also found between 50-75 DAS and 75 DAS - at harvest stage of crop.

**Table 3:** Effect of foliar application of nutrients on leaf area index, crop growth rate and relative growth rate of Horsegram

Treatments	Leaf area index				Crop growth rate (g day <sup>-1</sup> plant <sup>-1</sup> )				Relative growth rate (g g <sup>-1</sup> day <sup>-1</sup> )		
	25 DAS	50 DAS	75 DAS	At harvest	0-25 DAS	25-50 DAS	50-75 DAS	75 DAS-harvest	25-50 DAS	50-75 DAS	75 DAS-harvest
T <sub>1</sub> Control	0.224	0.420	1.070	0.548	0.0144	0.127	0.069	0.019	0.091	0.0159	0.0035
T <sub>2</sub> RDN	0.276	0.525	1.322	0.672	0.0177	0.151	0.085	0.026	0.090	0.0163	0.0039
T <sub>3</sub> RDN + 2% Urea spray	0.280	0.658	1.648	0.823	0.0180	0.185	0.105	0.032	0.096	0.0166	0.0039
T <sub>4</sub> RDN + 2% SSP spray	0.294	0.651	1.628	0.816	0.0192	0.182	0.104	0.032	0.094	0.0167	0.0039
T <sub>5</sub> RDN + 2% DAP spray	0.293	0.757	1.901	0.946	0.0188	0.212	0.121	0.039	0.100	0.0168	0.0042
T <sub>6</sub> RDN + 2% MOP spray	0.287	0.640	1.602	0.805	0.0184	0.182	0.104	0.032	0.095	0.0167	0.0039
T <sub>7</sub> RDN + 2% NPK (19:19:19) spray	0.282	0.762	1.949	0.955	0.0181	0.215	0.123	0.042	0.102	0.0169	0.0044
T <sub>8</sub> RDN + 250 ppm Cycocel (CCC) spray	0.272	0.633	1.588	0.799	0.0176	0.181	0.102	0.030	0.096	0.0166	0.0037
T <sub>9</sub> RDN + Water spray	0.270	0.528	1.355	0.675	0.0172	0.154	0.086	0.025	0.091	0.0164	0.0037
S.Em ±	0.015	0.031	0.07	0.033	-	-	-	-	-	-	-
CD (P=0.05)	0.045	0.093	0.21	0.10	-	-	-	-	-	-	-

### Post-harvest observations

#### Number of pods plant<sup>-1</sup>

The highest number of pods (31.77) was recorded under T<sub>7</sub> RDN + 2% NPK (19:19:19) spray which was significantly superior over all the other treatments but at par with treatment T<sub>5</sub> RDN + 2% DAP spray. While significantly the lowest number of pods (19.43) was recorded in T<sub>1</sub> control. This result was confirmative with Suryawanshi (2019) [13] and Deore *et al.* (2021) [4].

#### Pod length (cm)

The highest length of pods (5.48 cm) was recorded under T<sub>7</sub>

RDN + 2% NPK (19:19:19) spray which was significantly superior over all the other treatments but at par with treatment T<sub>5</sub> RDN + 2% DAP spray. While significantly the lowest length of pods (3.10 cm) was recorded in T<sub>1</sub> control. This result was confirmative with Suryawanshi (2019) [13] and Deore *et al.* (2021) [4].

#### Number of seeds pod<sup>-1</sup>

In different foliar application practices, number of seeds was reported maximum (5.82) under treatment T<sub>7</sub> RDN + 2% NPK (19:19:19) spray which was significantly superior over all the other treatments but at par with treatment T<sub>5</sub> RDN +

2% DAP spray. While significantly the lowest number of seeds (3.37) was recorded in T<sub>1</sub> control. This result was found to be similar by Deore *et al.* (2021) [4].

#### Test weight (g)

The highest test weight (33.78 g) was recorded under treatment T<sub>7</sub> RDN + 2% NPK (19:19:19) spray which was significantly superior over all the other treatments and at par with treatments T<sub>5</sub> RDN + 2% DAP spray while significantly the lowest value of test weight (23.10) was recorded in T<sub>1</sub> control. This result was confirmative with Deore *et al.* (2021) [4].

#### Grain yield (q ha<sup>-1</sup>)

The highest grain yield (11.92 q ha<sup>-1</sup>) was recorded with the treatment T<sub>7</sub> RDN + 2% NPK (19:19:19) spray which was significantly superior over all the other treatments but at par with T<sub>5</sub> RDN + 2% DAP spray. Whereas significantly lower value of grain yield (5.14 q ha<sup>-1</sup>) was recorded under T<sub>1</sub> control. In treatment T<sub>7</sub> – RDN + 2% NPK (19:19:19) spray produce maximum yield may be due to higher growth and yield attributes under this treatment. This result was confirmative with Jadhav and Kulkarni (2016) [5], Kachlam *et al.* (2019), Lakshmy *et al.* (2020) and Deore *et al.* (2021) [4].

#### Stover yield (q ha<sup>-1</sup>)

The highest stover yield (17.06 q ha<sup>-1</sup>) was recorded with the

treatment T<sub>7</sub> RDN + 2% NPK (19:19:19) spray which was significantly superior over all the other treatments at par with T<sub>5</sub> RDN + 2% DAP spray. Whereas significantly lower value of stover yield (9.60 q ha<sup>-1</sup>) was recorded under T<sub>1</sub> control. The possible reason for increase in stover yields in treatment T<sub>7</sub> – RDN + 2% NPK (19:19:19) spray might be due to cumulative effect of improvement in growth characters under this treatment. This result was found to be similar by Kachlam *et al.* (2019), Lakshmy *et al.* (2020) and Deore *et al.* (2021) [4].

#### Biological yield (q ha<sup>-1</sup>)

The highest biological yield (28.98 q ha<sup>-1</sup>) was recorded with the treatment T<sub>7</sub> RDN + 2% NPK (19:19:19) spray which was significantly superior over all the other treatments but at par with T<sub>5</sub> RDN + 2% DAP spray. Whereas significantly lower value of biological yield (14.74 q ha<sup>-1</sup>) was recorded under T<sub>1</sub> control. The results are in close association with Suryawanshi (2019) [13].

#### Harvest index (%)

Harvest index numerically higher (41.13%) was recorded with the treatment T<sub>7</sub> RDN + 2% NPK (19:19:19) spray followed T<sub>5</sub> RDN + 2% DAP spray. Whereas lower value of harvest index (34.87%) was recorded under T<sub>1</sub> control.

**Table 4:** Effect of foliar application of nutrients on number of pods, number of seeds, pod length and test weight of Horsegram

Treatments	Number of pods (plant <sup>-1</sup> )	Number of seeds (pod <sup>-1</sup> )	Pod length (cm)	Test weight (g)	Grain yield (q ha <sup>-1</sup> )	Stover yield (q ha <sup>-1</sup> )	Biological yield (q ha <sup>-1</sup> )	Harvest index (%)
T <sub>1</sub> Control	19.43	3.37	3.10	23.10	5.14	9.60	14.74	34.87
T <sub>2</sub> RDN	22.64	4.04	3.72	26.43	6.94	11.64	18.58	37.35
T <sub>3</sub> RDN + 2% Urea spray	27.88	5.01	4.64	30.30	9.80	14.72	24.52	39.96
T <sub>4</sub> RDN + 2% SSP spray	26.51	4.91	4.58	30.15	9.26	14.47	23.73	39.02
T <sub>5</sub> RDN + 2% DAP spray	31.08	5.68	5.30	33.63	11.49	16.95	28.45	40.38
T <sub>6</sub> RDN + 2% MOP spray	26.45	4.85	4.49	30.06	8.91	14.28	23.19	38.42
T <sub>7</sub> RDN + 2% NPK (19:19:19) spray	31.77	5.82	5.48	33.78	11.92	17.06	28.98	41.13
T <sub>8</sub> RDN + 250 ppm Cycocel (CCC) spray	25.95	4.76	4.42	29.93	8.76	14.14	22.93	38.25
T <sub>9</sub> RDN + Water spray	22.73	4.10	3.81	26.62	7.05	11.72	18.77	37.55
S.Em ±	1.06	0.21	0.19	1.09	0.52	0.64	1.21	-
CD (P=0.05)	3.18	0.64	0.58	3.28	1.55	1.91	3.64	-

#### Conclusion

On the basis of present investigation, it can be concluded that: All foliar application treatments and RDN shows superiority over control in respect of growth parameters *viz.*, plant height, number of branches plant<sup>-1</sup>, number of leaves plant<sup>-1</sup>, dry matter accumulation (g plant<sup>-1</sup>), number of root nodule plant<sup>-1</sup> and nodule dry weight (mg plant<sup>-1</sup>) of Horsegram. The treatment T<sub>7</sub> (RDN + 2% NPK 19:19:19 spray) recorded significantly higher growth attributes under study, but was at par with treatment T<sub>5</sub> (RDN + 2% DAP spray). Treatment T<sub>7</sub> (RDN + 2% NPK 19:19:19 spray) recorded significantly higher yield attributes *viz.*, number of pods plant<sup>-1</sup>, number of seeds pod<sup>-1</sup>, pod length (cm), test weight (g) and grain yield, stover yield and biological yield, of Horsegram, but was at par with T<sub>5</sub> (RDN + 2% DAP spray). Control (T<sub>1</sub>) treatment shows significantly lowest value of these parameters.

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