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EFFECT OF SILICA APPLICATION AND CUTTING MANAGEMENT ON FODDER QUALITY OF OAT (*AVENA SATIVA* L.) CV. PHULE HARITA

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SUMMARY

A field experiment was carried out at AICRP on Forage Crops & Utilization, Mahatma Phule Krishi Vidyapeeth, Rahuri, Dist. Ahmednagar (Maharashtra) during *Rabi*, 2016-2019. Silica was applied in soil to high yielding but lodging susceptible oat cultivar Phule Harita (RO-19) to maximize seed yield. The main plot treatments were application silica @ 0, 200, 300 and 400 kg/ha and sub plot treatments of cutting managements *i.e*. No cutting, cutting at 45 and 55 days after sowing. The forage quality parameters such as crude protein, acid detergent fibre, neutral detergent fibre, lignin, silica, digestibility dry matter yield and yield characters, straw and seed yield were increased with elevated levels of silica application. Whereas, *in vitro* dry matter digestibility and lodging per cent were decreased with increased level of Si application. The application of silicon dioxide @ 300 kg/ha and cutting at 45 DAS was recorded significantly superior digestibility dry matter yield with minimal lodging by enhancing lignin content of oat for higher seed production.

Key words : Forage oat, silica, cutting management, forage quality

Oat (*Avena sativa* L.) is one of the most important cultivated fodder crop in world. It is grown in India mainly for fodder purpose and nutritive grains (Wagh *et al.*, 2018). The fodder is mainly used as balanced diet for cattle, sheep and other domestic animals. Green fodder of oat contains about 30-35% dry matter and 10-12% protein on dry weight basis (Singh, 2019).The high yielding oat varieties are mostly susceptible to lodging, which is causes lower seed yield. It is observed that genotypes having higher solid pith area have higher lodging resistance capability which possess thicker sclerenchyma layer. Number of vascular bundles is positively correlated with lodging resistance lines because vascular bundles contribute to mechanical strength. To improve lodging resistance a more practical approach is selection for shorter and solid stems (Hasnath *et al.*, 2013), however it will reduce fodder or seed yield. Silicon applied as silicon dioxide (SiO_2) in fields is absorbed and appears to accumulate in leaves and promote mechanical strengthening of plant structures. Also silica in rice plants can increase photosynthesis, decrease susceptibility to disease and insect damage, prevent lodging, and alleviate water and various mineral stresses (Epstein, 1994). Current study showed that the mutant lines showed greater total potassium and total silicon content they were lodging tolerant and lodging tolerant varieties have higher total potassium and silicon content compared to lodging susceptible varieties (Rao, 2017). Silicon does not form a constituent of any cellular components but primarily deposited on the walls of epidermis and vascular tissues conferring strength, rigidity and resistance to pests and diseases. Silicon nutrition also manages many abiotic stresses including physical stresses like lodging, drought, radiation, high temperature, freezing and chemical stresses like salt, metal toxicity and nutrient imbalance (Epstein, 1994). In the present investigation silica was applied along with cutting management to reduce lodging and maximize seed yield of high yielding, lodging susceptible oat variety Phule Harita (RO-19). However, it was important to find out fodder quality of oat straw remain after harvesting of seed.

MATERIALS AND METHODS

A field experiment was conducted at AICRP on Forage Crops and Utilization, Mahatma Phule Krishi Vidyapeeth, Rahuri during *Rabi* 2016 to 2019. This zone comes under the semi-arid, sub-tropical and geographically situated between 19°47′ to 19°57′ North latitude and 74°32′ to 74°19′ East longitude and at altitude of 657 meters above mean sea level. Fig. 1.

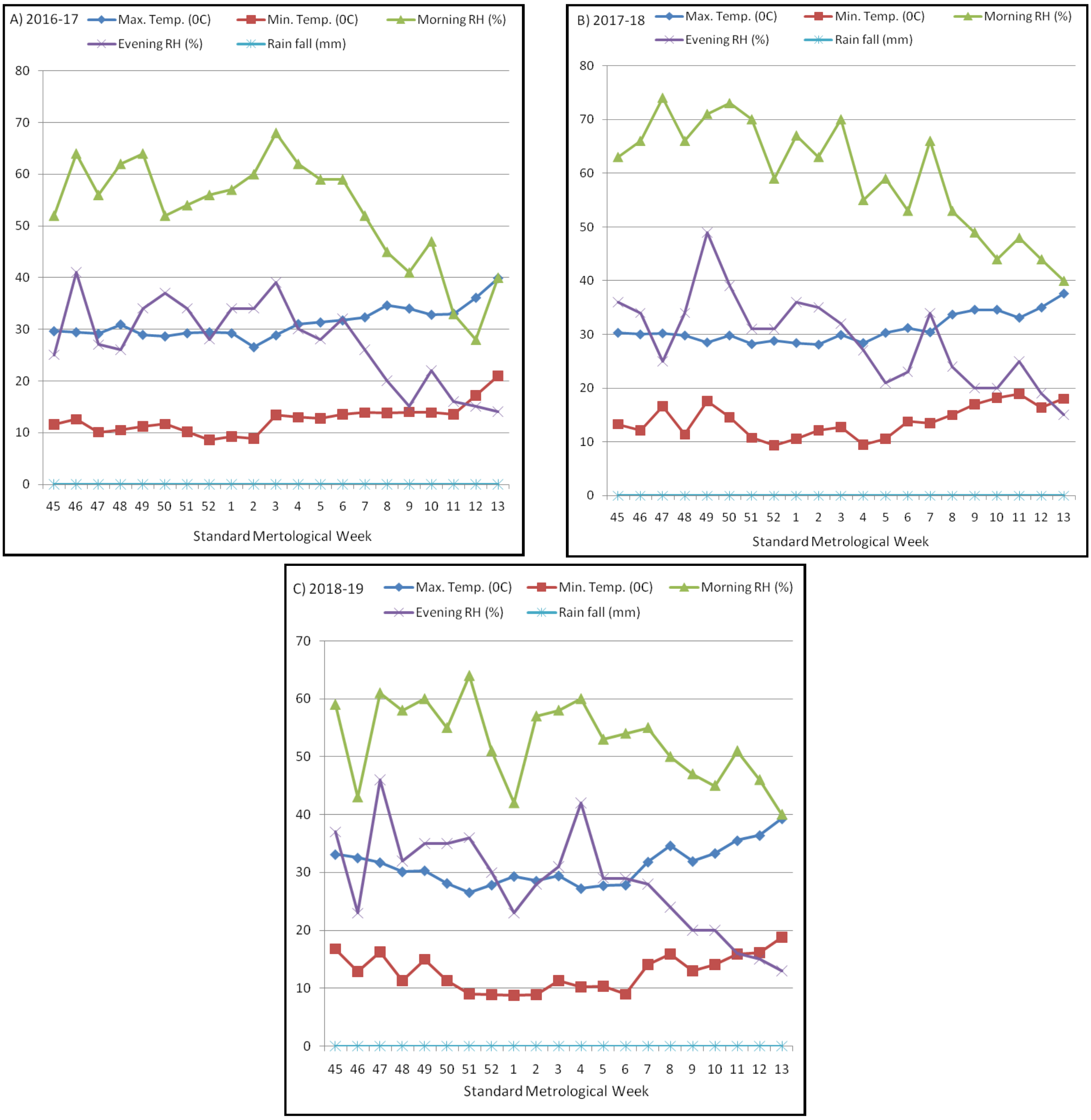

Fig. 1. Metrological data: A) 2016-2017, B) 2017-18 and C) 2018-19.

represents the weekly weather parameters *i.e.* minimum and maximum temperature (°C), morning and evening relative humidity (%) and rainfall (mm) during the years 2016-17, 2017-18 and 2018-19.

The soil of experimental field was clay loam in texture, with pH (8.3), EC (0.29 dS/m) and organic carbon (0.39%). The experiment was laid out in Factorial Randomized Block Design with three replications. The main plot treatments were application silica @ S_1-0 (Control), S_2-200, S_3-300 and S_4-400 kg ha-^{1} in the form SiO_2 and sub plot treatments of cutting managements *i.e.* C_1- No cutting, C_2-cutting at 45 DAS and C_3- cutting at 55 DAS. The chemical fertilizer dose of NPK applied was 120:50:40 kg/ha. The nitrogen in the form of Urea for no cut treatment (C_1) was applied in two equal splits *i.e.* at basal and 30 DAS, while in case of C_2 and C_3 in three equal splits *i.e.* at basal, 30 DAS and after 1st cut of green forage and application of total recommended dose of P_2O_5 in the form of Single Super Phosphate and K_2O in the form of Muriate of Potash as basal dose for all treatments. After harvesting of seed the remainder fodder samples were oven dried until constant weight to calculate dry matter yield (DMY). The dried plant samples were ground to pass through 1 mm sieve. The samples were analyzed for crude protein (CP) by Micro-Kjeldahl method, cell wall constituents *i.e.* acid detergent fibre (ADF), neutral detergent fibre (NDF) and lignin, silica and *in vitro* dry matter digestibility (IVDMD) with some modification of using goat rumen liquor. The lodging percent of crop was calculated based on per cent area affected.

RESULTS AND DISCUSSION

The fodder quality and yield attributes of oat variety Phule Harita was influenced significantly due to application of silica and cutting management (Table 1). Significantly higher crude protein content (5.62%), lignin (12.96%), silica (3.29 %), DDM (55.28 q/ha), straw yield (109.38 q/ha), seed yield (15.78 q/ha) and lowest lodging per cent (41.41%) was recorded on application of silica @ 400 kg/ha than other treatments, however lignin per cent (12.84%) and lodging per cent (42.48%) was at par with silica application @ 300 kg/ha. Significantly lowest ADF (38.86%), NDF (56.14%) and IVDMD (60.67%) were recorded in the control treatment (S_1). Although, DDM and straw yield was found highest in application of silica @ 400 kg/ha (S_4), which was at par with treatments S_3 and S_2. As regards to cutting management, cutting at 45 DAS (C_2) recorded significantly higher crude protein content (5.35%), IVDMD (58.07%), DDM (56.10 q/ha), seed yield (16.59 q/ha), however, it was at par with treatment C_3 for crude protein and IVDMD. Similar results were reported by Patil *et al*., (2018) where application of silicon along with general recommended dose of fertilizers to rice plants resulted in the significant increase in grain and straw yield, uptake of silica, nitrogen, phosphorus and potassium in straw. Patil *et al.* (2018a) reported silicon application by different sources increased dry matter, grain and straw yield and uptake of nitrogen, phosphorus, potassium and silica in rice straw. Van Soest and Jones (1968) reported decrease in digestibility in grasses due to silica.

The cutting of oat at 45 DAS (C_2) and cutting at 55 DAS (C_3) recorded at par values for per cent lodging and silica content. No cut treatment recorded the lowest ADF (45.18 %), NDF (61.02 %) and highest straw yield (106.92 q/ha) however, NDF was at par with treatment of cut at 45 DAS. Significantly highest lignin content was recorded by cut at 55 DAS. Kadam *et al.* (2019) reported similar observations that cutting at 50, 60 and 70 DAS increased crude fibre content and no variation in crude protein at 50 and 60 DAS in fodder oat.

Overall, crude protein, ADF, NDF, lignin, silica, DDM, straw and seed yield were found increased with elevated levels of silica application. While, IVDMD and lodging per cent were decreased with increased level of Si application. With increase in cutting DAS the parameters, crude protein, ADF, NDF, lignin, silica and IVDMD, DDM, and seed yield

TABLE 1

Effect of silica application on fodder quality and yield parameters of oat straw variety RO-19 (Pooled mean of three years)

Treatments	CP (%)	ADF (%)	NDF (%)	IVDMD (%)	Lignin (%)	Silica (%)	DDM (q/ha)	Straw yield (q/ha)	Seed yield (q/ha)	Lodging (%)
Silicon dioxide (kg/ha)										
S_1–0 (Control)	5.04	38.86	56.14	60.67	8.55	1.67	49.20	81.62	13.03	51.26
S_2–200	5.12	43.77	60.68	52.88	10.39	2.60	53.96	103.23	14.20	46.15
S_3–300	5.26	50.88	63.79	52.00	12.84	2.94	54.00	106.77	14.92	42.48
S_4–400	5.62	51.80	67.77	51.21	12.96	3.29	55.28	109.38	15.78	41.41
S. Em±	0.06	0.35	0.48	1.90	0.20	0.05	0.89	3.65	0.40	1.53
C. D. (P=0.05)	0.18	1.00	1.37	5.48	0.57	0.15	2.57	10.51	1.16	4.40
Cutting management (DAS)										
C_1–No cut	5.10	45.18	61.02	47.92	10.54	2.54	49.85	106.92	12.69	48.75
C_2–45	5.35	46.50	62.09	58.67	11.08	2.62	56.10	95.29	16.59	44.97
C_3–55	5.34	47.30	63.18	55.98	11.95	2.72	53.39	98.55	14.18	42.25
S. Em±	0.05	0.30	0.41	1.65	0.17	0.05	0.77	3.16	0.35	1.32
C. D. (P=0.05)	0.15	0.87	1.19	4.74	0.49	0.13	2.23	9.10	1.01	3.81
Interaction (S x C)										
S. Em±	0.11	0.60	0.83	3.29	0.34	0.09	1.55	6.32	0.70	2.65
C. D. (P=0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
General Mean	5.26	46.33	62.09	54.19	11.19	2.63	53.11	100.25	14.48	45.32
C.V. %	3.47	2.26	2.30	5.52	5.30	5.98	5.04	10.92	8.37	10.12

of straw tends to increased whereas, straw yield and lodging per cent were decreased.

CONCLUSION

It could be concluded that, application of silicon dioxide @ 300 kg/ha and cutting at 45 DAS and left for seed is beneficial for increasing lignification for achieving higher seed yield, digestibility dry matter yield with minimal lodging of oat in cv. Phule Harita.

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