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Effect of integrated nutrient management on growth, yield of Indian mustard (*Brassica juncea* L.) Cv. Sangam

Vinod Kumar Boddepalli, Arun A David, Tarence Thomas and Smriti Rao

Abstract
A field study was conducted on the "Effect of Integrated Nutrient Management on soil properties, Growth, yield and Quality of Indian Mustard (B*rassica juncea* L.) var. Sangam.", at the Soil Science Research Farm, Sam Higginbottom University of Agriculture, Technology & Sciences, Prayagraj during rabi season 2018-2019. The soil of experimental area falls in order Inceptisol and soil texture was sandy loam. The design applied for statistical analysis was carried out with 2x3 factorial randomized block design having two factors with three levels of NPK @ 0%, 50% & 100% ha^{-1}, three levels of Organics (Poultry manure and Vermicomposting) @ 0%, 50% & 100% ha^{-1} respectively. The result showed that plant height, no. of branches, no. of leaves, fresh weight, dry weight, test weight, total seed yield and total straw yield during 30, 60, 90 &120 DAS were shown significantly increased with application of 100 % NPK & organic fertilizers. Growth parameters and yield parameters increased significantly in T_8 and T_5 treatments. The lowest values related to all parameters were obtained in control plot treatment.

Keywords: Plant height, Number of branches, Number of leaves, Fresh weight, Dry weight, Total seed yield, Total straw yield, Test weight, Indian mustard

Introduction
Globally, India accounts for 17.27% and 9.07% of the total acreage and production of rapeseed-mustard (USDA 2016) [16] respectively. India is the third largest rapeseed-mustard producer in the world after Canada and China. This crop accounts for nearly one-third of the oil produced in India, making it the country's key edible oilseed crop. In India, it is grown on 5.8 million hectare, with an annual production of 6.3 million tonnes during 2014-15. The current per capita consumption of 14.3 kg $year^{-1}$ in 2012- 13 in India is considerably lower than the global average of 24 kg $year^{-1}$. Nearly 30.7% area under rapeseed mustard is under Indian mustard (*Brassica juncea*. L) is predominantly cultivated in the states of Rajasthan, Uttar Pradesh, Haryana, Madhya Pradesh, and Gujarat which contribute 81.5% area and 87.5% production. Indian mustard occupies more than 70% of the area under rapeseed-mustard group of crops grown in India. The production of rapeseed mustard in India was 8.0 million tonnes with productivity of 1188 kg ha^{-1} and area harvested 6.7 million hectares Economic survey, (2014-15) [1]. Generally, pulse and oilseed crops are raised under rainfed conditions with low input and poor management practices leading to lower productivity level Lal *et al*., (2015) [4]. Yield potentials of the crop, can be realized by balanced and efficient use of organic and inorganic sources of nutrient Meena *et al*., (2016) [8] and also use of suitable agronomic package practices to crop. Imbalanced nutrition is one of the important constraints towards higher mustard productivity, oil content and other quality parameters Lal *et al*., (2016) [5]. Intensification of agriculture coupled with use of high analysis fertilizers, deprived of secondary and micronutrients, has led to widespread deficiency of these nutrients which has further aggravated the situation because of restricted or no application of organic manures. The deficiency of sulphur, zinc and boron is very common in many states. In Uttar Pradesh, 53% of the soils are deficient in sulphur, 60% deficient in zinc and 12% deficient in boron Anonymous, (2014). Nutrient indexing work on soils and crops done at the Pantnagar revealed that negative balance of sulphur, zinc and boron is becoming evident in Tarai region Srivastava *et al*., (2006) [13]. Rapeseed-mustard requires relatively large amount of these nutrients for realization of yield potential but inadequate supply often leads to low productivity. Hence, it becomes imperative to increase crop productivity to provide balanced

and adequate nutrition through organic and inorganic sources. Use of total organic or inorganic nutrient sources has few limitations. Therefore, judicious use of organic and inorganic sources of nutrients is needed for enhancing productivity of rapeseed-mustard. Integrated use of organic and inorganic fertilizers not only ensures availability of all the essential plant nutrients but also improves the soil chemical, biological properties and crop productivity Thakur *et al*., (2009) [15]; Meena *et al*., (2015) [7]. Use of farm yard manure (FYM), vermicompost (VC) and bio-fertilizers like Azotobacter in judicious combination with fertilizers can facilitate profitable and sustainable production and are found to improve physical, chemical and biological soil properties Shroff and Devasthali, (1992) [11]. Similarly, Meena *et al*., (2014) [6] reported that soil quality also improved with the application of organic manures like FYM, leaf compost and VC. In Tarai region of Uttarakhand and western UP, the mustard crop is mainly sown late after harvest of rice under rice-mustard-sugarcane cropping system. The yield levels are low under late sown condition. The technologies are available on nutrient management particularly as integrated nutrient management in normal sown condition in mustard. But very little information is available on organic and inorganic nutrient management in late sown condition. In order to enhance the productivity of late sown mustard, it is important to develop suitable nutrient management practices for mustard to boost its growth. Keeping in view the above facts, and to exploit the highest potential of the mustard under late sown condition, the present investigation was carried out to study the effect of nutrient management practices on seed yield of Indian mustard (*Brassica juncea* L.)" under late sown condition and its effect on soil health.

Materials and Methods

The present study entitled "Effect of Integrated Nutrient Management on growth, yield of Indian Mustard (*Brassica juncea* L.) var. Sangam." comprise of a field experiment which was carried out at the Soil Science Research Farm, Sam Higginbottom University of Agriculture Technology and Sciences Prayagraj during Rabi season 2018, which is located at 25^0. 27^1 N latitude, $81^0.56^1$ E longitude and 98 m above the mean sea level. The detail of the experimental site, soil and climate is described in this chapter together with the experimental design, layout plan, cultural practice and techniques employed for the parameters. The area of Prayagraj district comes under subtropical belt in the South East Uttar Pradesh, which experience extremely hot summer and fairly winter. The maximum temperature of the location reaches up to 46^0C-48^0C and seldom falls as 40^0C – 50^0C. The relative humidity ranged between 20 to 94 %. The average rainfall in this area is around 1100 mm annually. It comes under subtropical climate receiving the mean annual rainfall of about 1100 mm, major rainfall from July to end of September. However, occasional precipitation was also not uncommon during winter. The winter months were cold while summer months were very hot and dry. The minimum temperature during the crop season was to be 25.01 ^{0}C and the maximum is to be 41.94 ^{0}C. The minimum humidity was 42.70% and maximum was to be 93.37%.

Experiment will be laid out in 2x3 factorial randomized block design (Fisher) with three levels of NPK and Organics (poultry manure & vermicomposting) plot size was 2x2 m^2 for crop seed rate is 5 kg ha^{-1} (*Brassica juncea* L.) var. Sangam. Mustard sowing was done on 6 November 2018 and the source of Nitrogen, Phosphorus, Potassium & Poultry manure, Vermicomposting were Urea, DAP, MOP, Poultry Manure and Vermicompost respectively. Basal dose of fertilizer was applied in respective plots according to treatment allocation uniform furrows opened by about 5 cm. All the agronomic practices were carried out uniformly to raise the crop. The crop was harvested on 3st week of March 2019.

Table 1: The treatments consisted of nine combination source of fertilizer

Treatment	Treatment Combination
T_0	@ 0 % NPK@ 0% (Vermicompost, Poultry manure)
T_1	@ 50 % NPK @ 0% (Vermicompost, Poultry manure)
T_2	@ 100 % NPK @0% (Vermicompost, Poultry manure)
T_3	@ 0 % NPK @ 50% (Vermicompost, Poultry manure)
T_4	@ 50 % NPK @50% (Vermicompost, Poultry manure)
T_5	@ 100 %NPK @ 50% (Vermicompost, Poultry manure)
T_6	@ 0 % NPK @ 100% (Vermicompost, Poultry manure)
T_7	@ 50 % NPK @ 100% (Vermicompost, Poultry manure)
T_8	@ 100 % NPK @ 100% (Vermicompost, Poultry manure)

Table 1: Recommended dose od Integrated nutrients for the trail

Treatment	Dosage ha^{-1} in percentage	Ratio of NPK	Symbol
Level of N,P&K	0% NPK as UREA, SSP and MOP	0:0:0 g/plot	n_0
	50% NPK as UREA, SSP and MOP	35:75:13 g/plot	n_1
	100% NPK as UREA, SSP and MOP	70::150:26 g/plot	n_2
Level of Vermicompost and Poultry manure	0% [Vermicompost, Poultry manure]	0:0 kg/plot	f_0
	50%[Vermicompost, Poultry manure]	1:4 kg/plot	f_1
	100%[Vermicompost, Poultry manure]	2:8 kg/plot	f_2

***Source*:** Hand book of agriculture (2010)

Results and Discussion

Plant height (cm)

As reported the plant height was recorded at 30, 60, 90 and 120 DAS. At 30, 60 and 90 the plant height was significant, but at 120 DAS it is non-significant. The maximum plant height was recorded at 30, 60, 90, and 120 were 30.2, 88.73, 119.46 and 124 was recorded in treatment T_8 (N_2 F_2). The minimum plant height was recorded at 30, 60, 90, and 120 were 14.66, 51.33, 85.46 and 117.33 was recorded in treatment T_0 (N_0 F_0). Similar results have also been recorded by Singh *et al.* (2006) [12].

Number of branches plant per plant

As reported the plant height was recorded at 30, 60, 90 and 120 DAS. The maximum number of branches was 5.1, 7.4, 9.5 and 9.4 at 30, 50, 90 and 120 DAS in F_2. The minimum number of branches was 7.1 and 7.1 at 90 and 120 DAS in F_0. The interaction between organics and inorganics on number of branches was significantly increased at 30, 60, 90 and 120 DAS and the maximum number of branches was recorded in treatment T_8 (N_2F_2). Similar results have also been recorded by Tripathi *et al.* (2011) [14], Chaurasia *et al.* (2009), Ramesh *et al.* (2009) [9].

Number of leaves plant per plant

As reported the plant height was recorded at 30, 60, 90 and 120 DAS. The maximum number of leaves was recorded at 30, 60, 90 and 120 DAS were 7.4, 13.8, 17.1, 10.5 in treatment T_8 and the minimum number of leaves were recorded at 30, 60, 90 and 120 DAS were 3.8, 7.7, 11.8 and 5.5 in T_0. The interaction between organics and inorganics on number of leaves was significant at 30, 60, 90 DAS and no significant at 120DAS. Similar results have also been recorded by Chaurasia *et al.* (2009) and Singh *et al.* (2011) [10].

Test weight (g) (1000 seeds weight)

As reported Test weight of seeds the data significantly increased 3.3<4.1<4.6 gm by the increasing levels of N:P:K from N_0 <N_1<N_2 and 3.7, 3.9, 4.5 gm significantly increased by the increasing levels of organics from F_0<F_1<F_2.. The interaction between the organics and inorganics on an average Test weight of seeds (g) showed a significant effect. The maximum Test weight of seeds (g) 5.3 g was recorded in T_8 (N_2F_2) and minimum Test weight of seeds (g) was 3.0 g recorded in T_0(N_0F_0). Similar results have also been recorded by Rundala *et al.* (2013) [10] and Tripathi *et al.* (2011) [10].

Table 3: Effect of Nitrogen, Phosphorus, Potassium & Poultry manure, Vermicomposting on Growth and yield parameters of mustard var. Sangam.

Treatments	Plant Height (cm)				No of Branches per plant				No of Leaves per plant			
	30 DAS	60 DAS	90 DAS	120 DAS	30 DAS	60 DAS	90 DAS	120 DAS	30 DAS	60 DAS	90 DAS	120 DAS
T_0	14.66	51.33	85.46	117.33	2.8	4.2	5.3	5.6	3.80	7.70	11.80	5.53
T_1	17.33	58.46	92.93	117.73	3.0	4.8	5.8	6.0	4.00	8.60	12.20	6.20
T_2	18.20	65.33	94.86	452.33	3.2	5.0	6.6	6.4	4.20	8.80	12.93	7.40
T_3	21.00	73.26	100.13	119.33	3.3	5.3	6.8	6.9	4.60	9.20	13.26	8.40
T_4	21.86	75.93	102.46	120.26	3.6	6.2	8.5	7.2	4.80	10.06	13.93	8.80
T_5	27.86	86.13	113.53	123.43	5.6	8.1	10.0	9.9	6.73	13.20	16.00	10.06
T_6	25.13	79.26	107.13	121.86	4.0	6.8	9.1	8.9	5.73	11.93	13.80	8.86
T_7	26.06	81.46	111.73	122.13	4.6	7.9	9.3	9.2	6.00	12.26	14.20	9.40
T_8	30.20	88.73	119.46	124.00	6.5	9.1	11.9	12.0	7.46	13.80	17.13	10.53
Mean	22.47	73.32	103.07	157.60	4.06	6.37	8.14	8.01	5.25	10.61	13.91	8.35
C.D at 5%	0.23	1.10	3.71	N/A	0.12	0.12	0.17	0.23	0.13	0.16	0.36	0.20

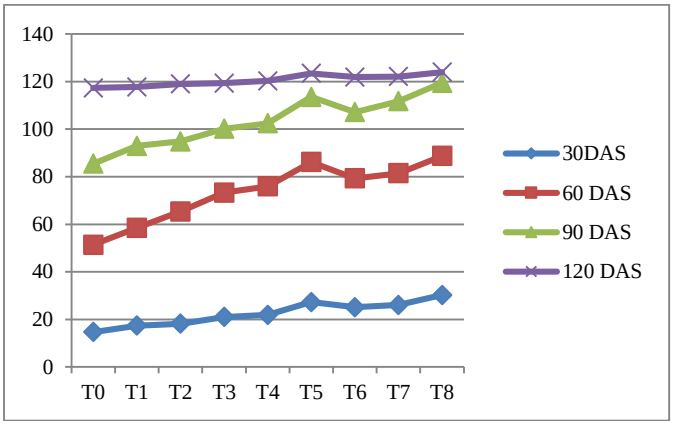

Fig 1: Plant height in cm

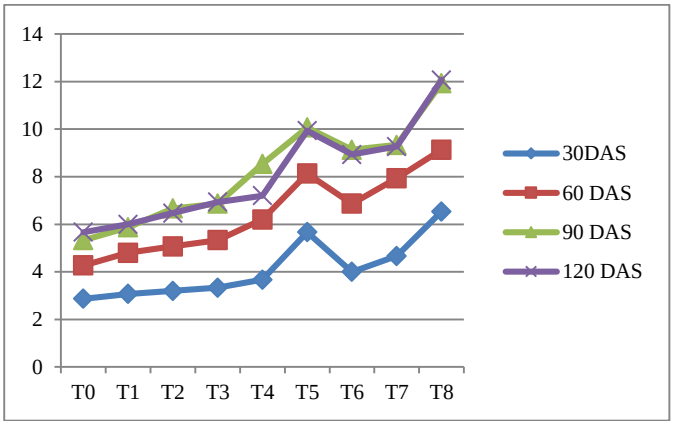

Fig 2: Number of Leaves per plant

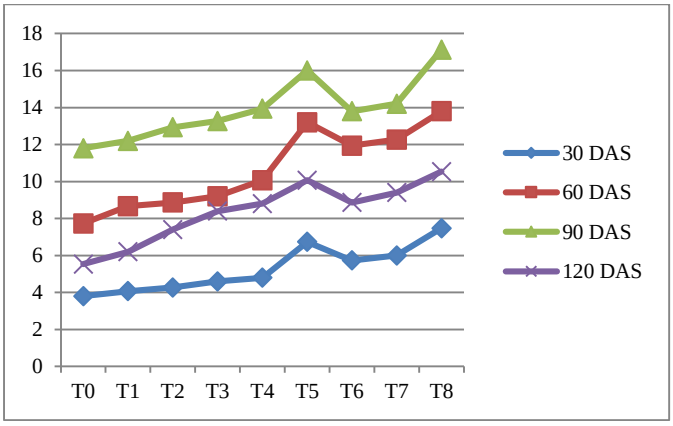

Fig 3: Number of Branches per plant

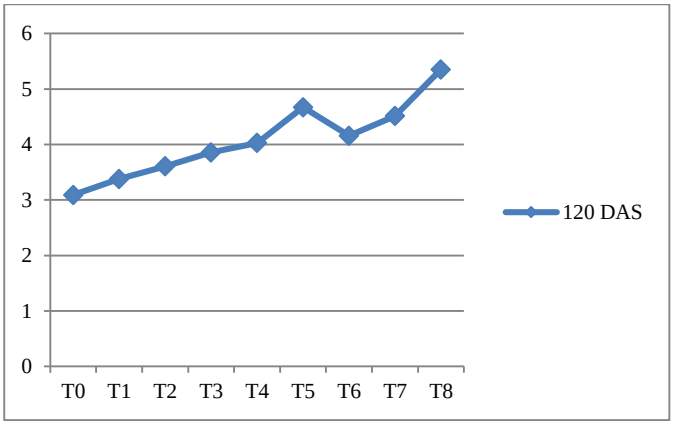

Fig 4: Test weight (g) of a plant

Fresh weight (g)

The fresh weight of data significantly increased 54.06<97.9<106.4 gm by the increasing levels of N:P:K from N_0 <N_1<N_2 and 75.35, 83.7, 99.3werg significantly increased by the increasing levels of organics from F_0<F_1<F_2.. The interaction between the organics and inorganics on an average fresh weight showed a significant effect. The maximum fresh weight 113.9g was recorded in T_8 (N_2F_2) and minimum fresh weight was 41.2g recorded in T_0(N_0F_0). Similar results have also been recorded by Hamid *et al.*(2003) [3].

Dry weight (g)

As reported the dry weight per plant (g) data significantly increased 19.5<37.6<43.4gm by the increasing levels of N:P:K from N_0 <N_1<N_2 and 27.6, 32.1, 40.7 g significantly increased by the increasing levels of organics from F_0<F_1<F_2.. The interaction between the organics and inorganics on an average Dry weight showed a significant effect. The maximum Dry weight 49.8g was recorded in T_8 (N_2F_2) and minimum Dry weight was 15.0g recorded in T_0 (N_0F_0). Similar results have also been recorded by Rundala *et al.* (2013) [10] and Tripathi *et al.* (2011) [10].

Total seed yield (q ha^{-1})

As reported Total seed yield (q ha^{-1}) the data significantly increased 12<18.3<19.8 (q ha^{-1}) by the increasing levels of N:P:K from N_0 <N_1<N_2 and 14.6, 16.5, 19 (q ha^{-1}) significantly increased by the increasing levels of organics from F_0<F_1<F_2.. The interaction between the organics and inorganics on an average Total seed yield (q ha^{-1}) showed a significant effect. The maximum Total seed yield (q ha^{-1}) 21 q ha^{-1} was recorded in T_8 (N_2F_2) and minimum Total seed yield (q ha^{-1}) was 10.3 q ha^{-1} recorded in T_0(N_0F_0). Similar results have also been recorded by Das *et al.* (2014) and Singh *et al.* (2011) [10].

Total straw yield (q ha^{-1})

As reported Total straw yield (q ha^{-1}) the data significantly increased 26.3<44.1<52.3 (q ha^{-1}) by the increasing levels of N:P:K from N_0 <N_1<N_2 and 34.4, 39.2, 49.1q ha^{-1} significantly increased by the increasing levels of organics from F_0<F_1<F_2.. The interaction between the organics and inorganics on an average Total straw yield (q ha^{-1}) showed a significant effect.

Table 3: Effect of integrated nutrient yield parameters of mustard cv. Sangam

Treatments	Fresh weight(g)	Dry yield (g)	Test weight (g)	Total seed yield (q ha^{-1})	Total straw yield (q ha^{-1})
T_0	41.20	15.06	3.09	10.33	22.00
T_1	50.40	18.90	3.38	12.00	25.66
T_2	70.60	24.60	3.60	13.66	31.33
T_3	82.73	29.20	3.85	15.33	35.66
T_4	97.53	35.73	4.02	17.33	41.00
T_5	113.46	47.93	4.67	22.33	55.66
T_6	102.13	38.60	4.15	18.33	54.60
T_7	103.26	41.93	4.51	20.33	51.00
T_8	113.93	49.80	5.35	21.00	60.33
Mean	86.13	33.52	4.06	16.73	41.91
C.D at 5%	0.89	0.65	0.19	2.12	1.86

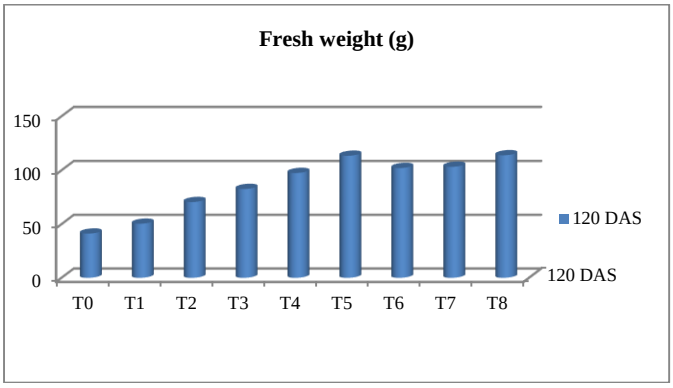

Fig 5: Fresh weight of mustard cv. Sangam

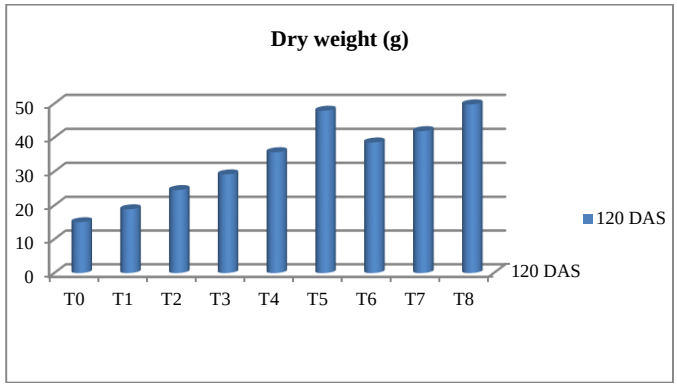

Fig 6: Dry weight of mustard cv. sangam

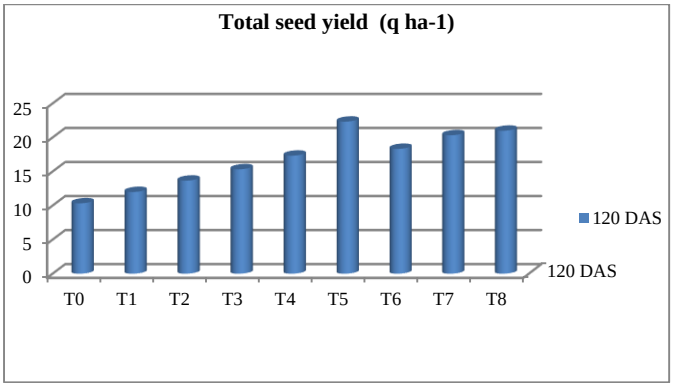

Fig 7: Total seed yield of mustard cv. Sangam

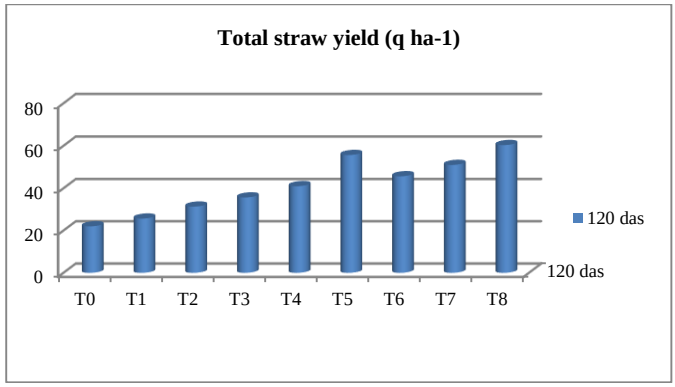

Fig 8: Total straw yield of mustard cv. sangam

The maximum Total straw yield q ha^{-1} 60.3q ha^{-1} was recorded in T_8 (N_2F_2) and minimum Total straw yield q ha^{-1} was 22 q ha^{-1} recorded in T_0 (N_0F_0). Similar results have also been recorded by Meena *et al.* (2013) and Tripathi *et al.* (2011) [14].

Conclusion

In the present investigation, it was apparent that application of Inorganic and organic enhanced plant height, number of branches $plant^{-1}$, no of leaves $plant^{-1}$, test weight, fresh weight, dry weight, total seed yield, total straw yield. Among the treatments, T_8 treatment (NPK 100% + Organics 100%) shown significant enhancing effect on mustard cv. Sangam. was found to be significant in terms of plant height, branches $plant^{-1}$, leaves $plant^{-1}$, test weight, fresh weight, dry weight, total Seed yield, total straw yield.

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