

## Original Research Article

### Seed yield, quality and economics of alfalfa seed production as influenced by INM during *kharif* season under southern dry zone of Karnataka

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#### ABSTRACT

The field experiment was carried out at the farm field of Krishi Vigyan Kendra, Konehalli, Tiptur taluk of Tumkuru district under southern dry zone of Karnataka during *Kharif* season, 2017-18 on seed yield, quality and economics of alfalfa seed production as influenced by integrated nutrient management. The nine treatments and four replications were laid out with Randomized complete block design (RCBD). The results of experiments revealed that the plants supplied with of 50 % RDF + 25 % N through vermicompost + *Rhizobium* + PSB + VAM resulted in highest fresh herb yield at first harvest (160.65 q/ha), herb yield after harvest of seeds (187.50q/ha), early flowering (27.00 days), 50% flowering (35.00 days), pod initiation (48.50 days), pod maturation (73.05 days) were recorded during *Kharif* season, while least fresh herb yield, delayed flowering, pod initiation, pod maturation were recorded with application of 10 t/ha FYM + 100 % N through FYM.

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The maximum pod (56.78 %), number of pods (228.75/pl), pod yield (19.90/pl), pod length (6.25 mm), pod weight (87.61 mg), seed (56.50 %), number of seeds (5.50/pod), test weight (3.33g), seed yield (223.38kg/ha) and highest net return per hectare during *Kharif* season were recorded with 50 % RDF + 25 % N through vermicompost + *Rhizobium* + PSB + VAM, while, minimum pod and seed characters, seed yield and net return per hectare were recorded with application of 10 t/ha FYM + 100 % N through FYM. Therefore, application of 50 % RDF + 25 % N through vermicompost + *Rhizobium* + PSB + VAM may be recommended for commercial seed production in Alfalfa during *kharif* season under southern dry zone of Karnataka.

**Keywords:** Alfalfa, INM, *Kharif*, nutrient, PSB, *Rhizobium*, seed and yield

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#### 1. INTRODUCTION

Alfalfa (*Medicago sativa* L.) is fodder crops of India, belongs to the family Fabaceae (Leguminaceae) and growing as annual as well as perennial crops with supply of green fodder continuously with 2-3 years from the same field, it is called as 'Queen of the fodder crops'. It was introduced into India in 1900 from North-West [1] and cultivated in Uttar Pradesh, Punjab, Gujarat, Haryana, Tamil Nadu, Maharashtra and Karnataka as the major growing states in the country. It is growing approximately in one million hectare of area and produced 60-130 tonnes of green fodder per hector per year with 186 - 280 kg/ha of seed yield in India. it is locally known as 'Kudure masale' in Karnataka.

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The Nutritive content of palatable fodder about 13.3 - 26.6% crude protein, calcium (0.92 - 2.9 %), phosphorus (0.14 - 0.66 %), carotene (9.27 mg/ 100g), fibre (20 -30 %) and vitamin A and C [4]. It also contain stachydrine as medicinal alkaloid and used for digestive, laxative, diuretic and treating against blood pressure, arthritis, hair loss, acidity and dropsy. The soil health and environment are deterioration due to continuous use of chemical fertilizers, which can be prevented by using the judicious combination of different sources of nutrients such as use of organic manures and bio-fertilizers along with balanced inorganic fertilizers, one of the eco-friendly approaches, which can be enhancing the productivity and sustainability [13]. By considering the importance of crop and role of integrated nutrient management, the

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experiment was conducted to study the seed yield, quality and economics of alfalfa seed production as influenced by INM during *kharif* season.

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## 2. MATERIALS AND METHOD

The field experiment was carried out at the farm field of Krishi Vigyan Kendra, Konehalli, Tiptur taluk of Tumkuru district under southern dry zone of Karnataka during *Kharif* season, 2017-18 on seed yield, quality and economics of alfalfa seed production as influenced by integrated nutrient management. The nine treatments and four replications were laid out with Randomized complete block design (RCBD). Plots were prepared with size of 4.32 sq.m (2.4 m x 1.8 m) area of red sandy loam soil. Alfalfa seeds of T-9 variety were treated with *Rhizobium meliloti* bio-fertilizers, applied recommended dose of fertilizers and organic manures with bio-fertilizers viz., *Phosphorous solubilizing bacteris (PSB)* and *vascular arabascular mycorrhiza (VAM)* as per treatments. The seeds were sown during *kharif* season with 30 cm x 15 cm spacing.

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### Treatment details

- T<sub>1</sub>: RDF (25:50:25 kg NPK/ha + 10 t/ha FYM)
- T<sub>2</sub>: 75% RDF + 25% N through FYM
- T<sub>3</sub>: 75% RDF + 25% N through Vermicompost
- T<sub>4</sub>: 75% RDF + 25% N through Poultry manure
- T<sub>5</sub>: 50% RDF + 25% N through FYM + Rhizobium + PSB+VAM
- T<sub>6</sub>: 50% RDF + 25% N through Vermicompost+ Rhizobium + PSB+VAM
- T<sub>7</sub>: 50% RDF + 25% N through Poultry manure+ Rhizobium + PSB+VAM
- T<sub>8</sub>: RDF + *Rhizobium* + PSB+VAM
- T<sub>9</sub>: 10 t/ha FYM + 100% N through FYM

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Table 1: **NPK content of Poultry manure, Vermi-compost and Farm yard manure before conducting the experiment**

Organic manures	N content (%)	P content (%)	K content (%)
Poultry manure	2.10	1.35	1.76
Vermicompost	1.60	0.86	0.98
Farm yard manure	0.95	0.62	0.75

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The first crop was harvested at 60 days after sowing and allowed it for further growth, flowering and to reach physiological maturity stage for obtaining the seeds. The observations on herb and seed yield were recorded using five plants per plot. These five plants were randomly selected by avoiding the border plants and labelled for recording the observations at harvest stage. The recorded data were analysed by suitable statistical analysis as per the procedure outlined, [14]. The results were compared at 5 per cent probability using Fischer's test.

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Benefit cost ratio (B:C ratio) :The benefit cost ratio was calculated by using the below mentioned formula

$$\text{B:C ratio} = \frac{\text{Gross income (Rs. ha}^{-1}\text{)}}{\text{Total cost of cultivation (Rs. ha}^{-1}\text{)}}$$

## 3. RESULTS AND DISCUSSION

### 3.1 Fresh weight of plants and herb yield of Alfalfa affected by INM during *kharif* season

The fresh weight of plant, herb yield/plot and herb yield/ha were recorded during *kharif* season at first harvest and herb yield after harvest of seeds are presented in Table 2. The plants supplied with 50 % RDF + 25 % N through vermicompost + *Rhizobium* + PSB + VAM during *kharif* season was recorded maximum fresh weight (133.11g/plant & 121.49g/plant), fresh herb yield (3.47kg/plot & 4.05kg/plot) and fresh herb yield (160.65q/ha & 187.50q/ha) at first harvest of herb and herb yield after harvest of seeds respectively, which was *at par* with the plants supplied with 50 % RDF + 25 % N through poultry manure + *Rhizobium* + PSB + VAM. Whereas application of 10 t/ha FYM + 100 % N through FYM during *kharif* season were recorded least fresh weight/plant, fresh herb yield/plot and fresh herb yield/ha at first harvest of herb and herb yield after harvest of seeds.

The highest fresh weight of plant and fresh herb yield might be due to that, vermin-compost is known to produce favorable effect on chemical, biological and physical factors in soil, that determines productivity and fertility status of soil and supply the nutrients in their available form, enhance the microbial population and provides sufficient energy for them to remain active [15]. It also provides both the vital macro-nutrient and micro-nutrients such as N, P, K, Ca, Mg, besides, *Rhizobium* has been increased the availability of N and helped in the synthesis of tryptophan as resulted in obtaining maximum herb yield. These results are in agreement with [20] in alfalfa, [9, 18, 8] in ashwagandha and [9] in davana.

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**Table 2: Fresh weight of plants and herb yield of Alfalfa affected by INM during *kharif* season**

Treatment	Fresh plant weight (g)		Fresh herb yield / plot (kg)		Fresh herb yield / hectare (g)		Cumulative herb yield
	1 <sup>st</sup> Harvest of herb	Herb weight after harvest of seeds	1 <sup>st</sup> Harvest of herb	Herb yield after harvest of seeds	1 <sup>st</sup> Harvest of herb	Herb yield after harvest of seeds	
T <sub>1</sub>	115.96	106.08	3.34	3.93	154.63	181.94	336.57
T <sub>2</sub>	103.37	96.58	3.23	3.81	149.54	176.39	325.93
T <sub>3</sub>	112.15	102.85	3.30	3.89	152.78	180.09	332.87
T <sub>4</sub>	110.15	100.06	3.27	3.87	151.39	179.17	330.56
T <sub>5</sub>	124.56	113.50	3.41	3.99	157.87	184.72	342.59
T <sub>6</sub>	133.11	121.49	3.47	4.05	160.65	187.50	348.15
T <sub>7</sub>	129.40	116.97	3.45	4.03	159.72	186.57	346.29
T <sub>8</sub>	119.87	109.68	3.38	3.60	156.48	166.67	323.15
T <sub>9</sub>	99.02	93.79	3.15	3.76	145.83	174.07	319.90
F- test	*	*	*	*	*	*	*
S.Em±	3.10	2.61	0.017	0.012	1.01	0.81	2.00
CD at 5 %	9.05	7.64	0.05	0.035	2.95	2.36	5.83

### 3.2 Effect of flowering characters by INM in Alfalfa during *kharif* season

Flowering characters such as days taken for flowering, pod initiation, pod maturation and number of flowers/plant were recorded during *kharif* season are presented in Table 3. The plants supplied with 50 % RDF + 25 % N through vermicompost + *Rhizobium* + PSB + VAM during *kharif* season was recorded in early flowering (27 days), 50% flowering (35 days), pod initiation (48.5 days), pod maturation (73 days) and highest number of flowers per plant (405) were recorded, which was *on par* with the application of 50 % RDF + 25 % N through poultry manure + *Rhizobium* + PSB + VAM in pod length. Whereas, application of 10 t/ha FYM + 100 % N through FYM during *kharif* season were recorded in delayed flowering, 50% flowering, pod initiation, pod maturation and least number of flowers.

This might be due to the integrated application of inorganic fertilizers and organic manure along with biofertilizers showing similar effect of growth regulators and provide in better uptake of nutrients by the plants as a result in better reproductive growth of the plants. The similar reports were found with [6] in Alfalfa, [12] in peppermint, [16] in Kalmegh, [2, 5] in chamomile.

**Table 3: Effect of flowering characters by INM in Alfalfa during *kharif* season.**

Treatment	No. of days for flowering	No. of days for 50% flowering	No. of flowers/plant	No. of days for pod initiation	No. of days for pod maturation
T <sub>1</sub>	28.55	36.10	386.50	50.13	75.30
T <sub>2</sub>	29.13	37.85	379.25	52.25	77.63
T <sub>3</sub>	28.60	36.10	385.75	50.13	75.35
T <sub>4</sub>	29.00	37.20	382.50	51.75	76.03
T <sub>5</sub>	27.55	35.60	396.63	49.10	74.28
T <sub>6</sub>	27.00	35.00	405.00	48.50	73.05
T <sub>7</sub>	27.10	35.50	399.25	48.75	73.75
T <sub>8</sub>	27.75	35.80	389.63	49.38	74.38
T <sub>9</sub>	29.38	38.00	376.00	53.25	78.25
F-test	*	*	*	*	*
S.Em±	0.15	0.18	2.78	0.12	0.38
CD at 5 %	0.44	0.54	8.14	0.34	1.12

### 3.3 Effect of pod quality by INM in Alfalfa during *kharif* season

The pod quality such as pod set per cent, number of pods/plant, number of filled pods, number of seeds/pod, pod yield, pod weight and pod length were recorded during *kharif* season are presented in Table 4. The application of 50 % RDF + 25 % N through vermicompost + *Rhizobium* + PSB + VAM during *kharif* season were recorded maximum pod set per cent (56.78%), number of pods (228.7/plant), number of filled pods (129.2/plant), pod yield (19.9/plant), pod weight (87.61mg) and pod length (6.25mm). Whereas, application of 10 t/ha FYM + 100 % N through FYM during *kharif* season were recorded with minimum pod set per cent, number of pods/plant, number of filled pods/plant, pod yield/plant, pod weight and pod length. The good pod quality could be due to application of *Rhizobium*, PSB and VAM enhances vegetative growth, better of photosynthetic and metabolites as resulted in early flowering, pod initiation and which improved the pod characters. The results are similar with the works of [7] in Ambrette.

**Table 4: Effect of pod quality by INM in Alfalfa during *kharif* season**

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Treatment	Pod set (%)	No. of pods per plant	No. of filled pods per plant	Pod yield per plant (g)	Pod length (mm)	Pod weight (mg)
T <sub>1</sub>	54.98	212.50	111.50	18.02	5.90	85.38
T <sub>2</sub>	53.92	204.50	101.50	16.95	5.63	84.35
T <sub>3</sub>	55.02	211.95	111.50	18.00	5.85	85.40
T <sub>4</sub>	54.58	208.75	106.55	17.56	5.80	85.25
T <sub>5</sub>	56.16	222.25	121.75	19.10	6.00	86.15
T <sub>6</sub>	56.78	228.75	129.25	19.90	6.25	87.61
T <sub>7</sub>	56.43	225.50	127.50	19.50	6.15	86.03
T <sub>8</sub>	56.14	220.00	119.25	18.54	5.98	85.95
T <sub>9</sub>	53.66	201.75	98.00	16.58	5.58	83.75
<b>F- test</b>	*	*	*	*	*	*
<b>S.Em±</b>	0.22	2.12	2.10	0.25	0.07	0.41
<b>CD at 5 %</b>	0.64	6.21	6.13	0.73	0.22	1.25

### 3.4 Effect of seed characters and seed yield by INM in Alfalfa during *kharif* season

The Effect of seed characters and seed yield by INM during *kharif* season are presented in Table 5. The plants supplied with 50 % RDF + 25 % N through vermicompost + *Rhizobium* + PSB + VAM during *kharif* season was recorded maximum seed set per cent (56.50%), number of seeds (5.50/pod), test weight (3.33g) and seed yield (2.07g/plant, 48.25g/plot & 223.38kg/ha). Whereas, application of 10 t/ha FYM + 100 % N through FYM during *kharif* season was recorded minimum seed set per cent, number of seeds/pod, test weight, seed yield. This might be due to attributed to adequate availability of nutrients sources at different growth stages through the integrated application of inorganic, organic and bio-fertilizers and sequential metamorphosis from source to sink. The similar results are findings with [17] in isabgol and also increased uptake of nitrogen by *rhizobium* fixation of atmospheric nitrogen. Besides, the optimum supply of nutrient could have helped in increased plant metabolic activity and source to sink relationship, thus, higher the yield by more number of seeds. Similar results were found with [3] in Ashwagandha.

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**Table 5: Effect of seed characters and seed yield by INM in Alfalfa during *kharif* season**

Treatment	Seed set per cent	No. of seeds per pod	Test weight (g)	Seed yield per plant (g/pl)	Seed yield per plot (g/plot)	Seed yield per hectore (kg/ha)
T <sub>1</sub>	52.47	4.70	3.16	1.95	43.63	201.99
T <sub>2</sub>	49.63	4.45	3.10	1.92	42.10	194.06
T <sub>3</sub>	52.61	4.71	3.14	1.95	43.53	201.34
T <sub>4</sub>	51.04	4.65	3.11	1.94	42.38	196.20
T <sub>5</sub>	54.78	5.20	3.20	2.00	46.25	214.12

T <sub>6</sub>	56.50	5.50	3.33	2.07	48.25	223.38
T <sub>7</sub>	56.04	5.38	3.24	2.03	47.00	217.59
T <sub>8</sub>	54.20	4.98	3.18	1.97	45.75	211.80
T <sub>9</sub>	48.57	4.35	3.09	1.91	41.38	191.57
F- test	*	*	*	*	*	*
S.Em±	0.24	0.10	0.42	0.02	0.64	2.75
CD at 5 %	0.70	0.29	NS	0.06	1.87	8.03

### 3.5 Effect of integrated nutrient management on economics of seed production in Alfalfa during *kharif* season

The economics of seed production in Alfalfa during *kharif* season are presented in Table 6. The plants supplied with 50 % RDF + 25 % N through vermicompost + *Rhizobium* + PSB + VAM during *kharif* season was obtained highest net return (Rs. 65,763/ha) and obtained the maximum cost benefit ratio (2.12) during *kharif* season with the application of 50 % RDF + 25 % N through poultry manure + *Rhizobium* + PSB + VAM. Whereas, the lowest net return (Rs. 51,824/ha) and B:C ratio (1.92) was obtained with the application of 10 t/ha FYM + 100 % N through FYM during *kharif* season. The highest net return and B:C ratio in seed production could be due to enhancement of growth and development by supplying of integrated nutrients to meet the required demand of the crop till physiological maturity, resulted in increased seed yield. Similar reports were found by [10, 11] in alfalfa.

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Table 6: Effect of INM on economics of seed production in Alfalfa during *kharif* season

Treatment	Economics of seed production during <i>kharif</i> season (Rs./ha)			
	Gross return	Cost of cultivation	Net return	B:C ratio
T <sub>1</sub>	114090	57199	56891	1.990
T <sub>2</sub>	109759	57063	52696	1.930
T <sub>3</sub>	113520	58360	55160	1.940
T <sub>4</sub>	110998	56987	54011	1.950
T <sub>5</sub>	120034	57558	62476	2.080
T <sub>6</sub>	124618	58855	65763	2.117
T <sub>7</sub>	121873	57482	64391	2.120
T <sub>8</sub>	118782	58487	60295	2.030
T <sub>9</sub>	108081	56257	51824	1.920

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#### 4. CONCLUSION

The study on seed yield, quality and economics of alfalfa seed production as influenced by INM during *kharif* season under southern dry zone of Karnataka revealed that, the application of 50 % RDF + 25 % N through vermicompost + *Rhizobium* + PSB + VAM has recorded the maximum seed yield, good quality and highest profit in seed production during *kharif* season. Therefore, 50 % RDF + 25 % N through vermicompost + *Rhizobium* + PSB + VAM may be recommended for commercial seed production in Alfalfa during *kharif* season under southern dry zone of Karnataka

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#### REFERENCES

1. Ahlawa IPS. Agronomy of Rabi Crops - Alfalfa, Division of Agronomy. Indian Agricultural Research Institute, New Delhi. 2007; pp-1-9.
2. Dastborhan DS, Zehtab-Salmansi S, Nasrollahzadeh S, Tavassoli AR. Effect of plant growth promoting rhizobacteria and nitrogen fertilizer on yield and essential oil of German chamomile (*Matricaria chamomilla* L.). Acta. Hort. 2012;9(4): 121-128.
3. Dubey PK, Pandey CS, Shakoor Khanday AB, Gaurav Mishra., Effect of integrated nutrient management on nutrient uptake, protein content and yield of fenugreek, International Journal of Food, Agricultural and Veterinary Sciences. 2012;2(1): 1-12.
4. Khalak A. Seed yield of Lucerne (*Medicago sativa* L.) varieties at different times of sowing and levels of fertilizer. M. Sc. (Agri.) Thesis, University Agricultural Sciences, Bengaluru. 1989,
5. Mohammadreza N, Mohammad M, Houseyn Z. Bahari B. Effect of different levels of nitrogen, phosphorous and potassium fertilizers on some agro morphological and biochemical traits of German chamomile (*Matricaria chamomilla* L.). Journal of Medicinal Plant Reseach. 2012; 6(2): 277-283.
6. Pankaniya RM, Tandel BB, Phamar JD. Effect of integrated nutrient management on growth, yield, nutrient uptake and economic of Lucerne (*Medicago sativa* L.). The Parma Innovation. 2023; 12(6): 1695-1697
7. Rajeswari R, Shakila A. Effect of integrated nutrient management practices on yield characters of ambrette (*Abelmoschus moschatus* Medic.). Plant Archives. 2015;15(1): 537-540.
8. Raju B, Mohana Chandra CN, Sreeramu BS, Farooqui AA, Chandre Gowda M. Influence of bio-inoculants under graded levels of fertilizer on growth, yield and quality of makoi (*Solanum nigrum* L.). International Journal Science and Nature. 2014;5(2): 246-248.
9. Ravirajashetty G, Kusuma MV, Venkatesha J, Sadashiv Nadukeri. Impact of integrated nutrient management on growth and yield of Davana (*Artemisia pallens* Wall.) under hill zone of Karnataka. International Journal of Development and Research. 2014;4(3): 757-759.
10. Rominger RS, Smith D. Peterson LA. Yield and chemical composition of alfalfa as influenced by nutrient levels. American Journal of Expert Agriculture. 2015;68(4): 573-577.
11. Ruixuan Xu, Haiming Zhao, Yongliang You, Ruixin Wu, Guibo Liu, Zhiqiang Sun, Bademuqiqige, and Yingjun Zhang, Effects of intercropping, nitrogen fertilization and corn plant density on yield, crude protein accumulation and ensiling characteristics of silage corn inter seeded into alfalfa stand. Agriculture. 2022;12:1 -15

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12. Sheykhholeslami Z, Almdari M, Qanbari S, Akbarzadeh M. Effect of organic and chemical fertilizer on yield and yield components of peppermint (*Mentha piperita* L.). American Journal of Experi. Agriculture. 2015; 6(4): 251-257.
13. Singh R, Munnu Singh, Akshata Srinivas, Prakasa Rao EVS, Puttanna K. Assessment of organic and inorganic fertilizers for growth, yield and essential oil quality of industrially important plant Patchouli (*Pogostemon cablin*), Journal of Essential oil Bearing Plants, 2015;18(1): 1-10
14. Sundararaj N, Nagaraju SS, Venkataramu MN, Jaganath MK. Design and analysis of field experiment. University of Agricultural Sciences, Bengaluru. 1972
15. Sunil JN. Effect of dates of planting and nitrogen levels on growth and yield of kalmegh (*Andrographis paniculata*). M. Sc. (Hort.) Thesis, University of Agricultural Sciences, Dharwad. 2010.
16. Sushma M, Aruna J. Effect of INM on vegetative growth, flowering and fruiting of *Andrographis paniculata*. Universal Journal of Agricultural Research. 2014;2(3): 93-96
17. Venkatesha NT, Kattimani KN, Madalageri MB, Hanamashetti SI, Gangadharappa PM, Devappa V. Integrated nutrient management in isabgol (*Plantago ovato* Forsk.). The Asian Journal of Horticulture. 2007; 25: 123- 127.
18. Vijay K, Vivek KS, Roshni A. Effect of different levels of nitrogen and phosphorous on growth, yield and quality of kalmegh (*Andrographis paniculata*). New Agriculturist, 2015; 26(1): 17-23.
19. Vishal G. Duhan BS. Kalmegh (*Andrographis paniculata*) crop as influenced by the application of farmyard manure (FYM) and inorganic phosphorous in typic torripsamments of Hisar. Journal of Medicinal Plant Research. 2013;7(46): 3337-3342.
20. Zhuanlin Ben, Yuan Li and Huimin Yang. Fertilizer application increases alfalfa yield and crude protein content: roles of fertilizer type, application rate, and environmental conditions. Research Square. 2023: pp 1-4.



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