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Influence of nutrient spray on growth and yield of chickpea (*Cicer arietinum* L.)

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Abstract
A field experiment was conducted during *Rabi* season 2023 at Crop Research Farm, Department of Agronomy, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Sciences And Technology. To determine "Influence of Nutrient Spray on Growth and Yield of chickpea *(Cicer arietinum* L.)". The result revealed that treatment 5 (RDF 100%+ Panchagavya 3%) recorded significant, higher plant height (49.23 cm), maximum nodules/plant (46.20), maximum branches/plant (19.53), higher dry weight (18.41 g), maximum number of pod/plant (54.93), maximum number of seeds/pod (1.98), higher Seed index (244.15 g), higher Seed yield (2.67 t/ha), higher stover yield (4.82 t/ha), maximum gross return (140443.30 INR/ha), maximum net return (93353.10 INR/ha), maximum benefit cost ratio (1.98) was also recorded in treatment 5 (RDF 100%+ Panchagavya 3%) as compared to other treatments was found to be productive as well as economically feasible.

Keywords: Chickpea, nutrient spray, growth, yield and economics

Introduction
Chickpea is a key legume with nutritious seeds. It belongs to the genus Cicer, family Fabaceae. As a pulse crop, it provides complete protein with all nine essential amino acids, making it ideal for vegetarians and vegans. Chickpea is a staple in many diets due to its rich nutrition. There are two main types of chickpeas: desi and kabuli. Desi chickpeas are small, angular, and have dark, rough seeds. Kabuli chickpeas are larger, with beaked, smooth, white or beige seeds. Kabuli types grow in temperate regions, while desi types thrive in semi-arid tropical areas. (Muehlbauer and Singh, 1987) [18]. However, several early-maturing Kabuli chickpea varieties have been developed recently, which can be cultivated in tropical regions. The seeds of chickpea contain approximately 22-24% protein, which is nearly double that of wheat and three times that of rice. They also consist of carbohydrates (about 61.51%), fat (4.5%), and are relatively low in anti-nutritional factors (Singh *at al.* 2022). Chickpeas are notably rich in protein (20.47 g/100 g), carbohydrates (62.95 g/100 g), fiber (12.2 g/100 g), phosphorus (252 mg/100 g), and various minerals such as calcium (57 mg/100 g), magnesium (79 mg/100 g), iron (4.31 mg/100 g), and zinc (15 mg/100 g). They have a low fat content, with most of it being polyunsaturated.
In the global scenario, India ranks first in chickpea production, with an impressive area of 148.11 lakh ha with a production of 180.95 lakh tonnes and an average productivity of 1222 kg/ha. (FAO, 2022) [7]. India currently ranks chickpea as the first most important pulse crop, accounting for nearly 34% of the total pulse area in the country. In India, chickpea is grown in 101.08 lakh ha area with a production of 115.70 lakh tonnes and productivity of 1145 kg/ha. Uttar Pradesh is one of the major chickpea producing state in India. In Uttar Pradesh, chickpea is grown in area of 5.83 lakh ha with production of 7.47 lakh tonnes and the average productivity is 1282 kg/ha (GOI, 2022) [9].
Foliar fertilization during the seed development stage of pulse crops is gaining attention for enhancing seed production. This method offers more efficient nutrient uptake than traditional soil application, especially in dry soil conditions. By spraying nutrients directly onto leaves, plants can absorb them more effectively, bypassing soil limitations. This direct uptake is crucial during seed development, ensuring essential nutrients are available when needed most. Foliar fertilization is effective because plants can quickly assimilate nutrients through their leaves,

supporting seed development and increasing crop yield. This approach is particularly beneficial under water stress, providing a targeted and efficient nutrient delivery system.

Nitrogen is vital for plant growth, being a key component of chlorophyll, protoplasm, nucleic acids, and proteins, which are essential for all proteins and enzymes that regulate biological processes. Phosphorus is crucial for energy storage and transfer in pulses. Early in plant development, it is needed for reproductive parts. In leguminous crops, phosphorus enhances rhizobial activity and root nodule formation, boosting nitrogen fixation. Potassium promotes root growth and overall plant health. It helps prevent lodging and increases resistance to pests and diseases, improving plant vitality.

Foliar fertilization is an economical method to supply plant nutrients that are lacking or unavailable in the soil. It provides immediate improvement in plant growth and development by delivering nutrients, hormones, stimulants, and other beneficial substances directly to the leaves, stems, and other aerial parts. This method enhances yield, quality, pest resistance, drought tolerance, and helps plants recover from transplant shock and weather damage. Applying foliar sprays at critical growth stages is crucial for optimal nutrient utilization and crop performance. Panchagavya, a traditional Indian organic product, consists of five cow-derived ingredients: dung, urine, milk, curd, and ghee. Historically used in rituals and Ayurvedic medicine, Panchagavya also serves as a fertilizer and pesticide in organic farming. It promotes plant growth and immunity, making it an effective bio-promoter. As a growth promoter (75%) and immunity booster (25%), Panchagavya supports sustainable organic farming without yield loss. (Vedivel, 2007) [35]. A biodigester is a system that biologically digests organic material either anaerobically (without oxygen) or aerobically (with oxygen), using microbes and bacteria. It can process various organic materials, including fats, greases, and animal manure. As a closed system, a biodigester eliminates odors and prevents flies and rodents, enhancing hygiene. It also reduces food waste disposal costs by decreasing hauling expenses. The processing capacity depends on the digester's size, with larger digesters handling more food. Biodigesters require maintenance but are generally easy to use. Urea, a commonly used foliar N-fertilizer, is noted for its high leaf penetration, low cost, and rapid absorption and hydrolysis by plants. (Witte *et al.*, 2002) [36].

Keeping in view the above fact, the present experiment was undertaken to find out the "Influence of Nutrient Spray on Growth and Yield of chickpea *(Cicer arietinum* L.*)*"

2. Materials and Methods

The experiment was conducted during *Rabi* season 2023 at Crop Research Farm, Department of Agronomy, SHUATS, Prayagraj (U.P). The soil of the experimental field was sandy loam in texture, a pH of 7.8 that was virtually neutral, low level of organic carbon (0.62%), available N (225 Kg/ha), P (38.2 kg/ha), K (240.7 kg/ha) and Zn (2.32 mg/kg). The treatment consists of two levels of RDF along with the combination of four levels of nutrient spray as a foliar spray and a control. The experiment was laid out in RBD with 9 treatments each replicated thrice. The treatment combinations are T_1 RDF 75%+ Panchgayvya 3%, T_2 RDF 75%+ Biodigester 10%, T_3 RDF 75%+ Cow urine 2, T_4 RDF 75%+ Urea 2%, T_5 RDF 100%+ Panchgayvya 3%, T_6 RDF 100%+ Biodigester 10%, T_7 RDF 100%+ Cow urine 2%, T_8 RDF 100%+ Urea 2%, T_9 (Control) 20:60:20 kg/ha. Data recorded on different aspects of crop, *viz.*, growth, yield attributes and yield were subjected to statistically analysed by analysis of variance method as described by Gomez and Gomez (1976) [8].

3. Result and Discussion

3.1 Growth Attributes

3.1.1 Plant height (cm)

The data revealed that significant and higher plant height (49.23 cm) was recorded in treatment 5 (RDF 100%+ Panchagavya 3%). However, treatment 6 (RDF 100%+ Biodigester 10%), was found to be statistically at par with treatment 5 (RDF 100%+ Panchagavya 3%). Significant and higher plant height was observed with the application of Nitrogen fertilizers which might be due to promote hasten growth in terms of higher plant height. Similar results were also reported by Balai *et al.* (2017) [3]. Significant and higher plant height was observed with the application of Phosphorus fertilizers which might be to the stimulating effect of phosphorus on plant process as phosphorus is a major constituent of plant cell nucleus and growing root tips which help in cell division and root elongation which results in vigorous growth of plants and extension root system leading to increase in growth parameters. Similar results were also reported by Pingoliya *et al.* (2014) [25]. Further, significant and higher plant height was observed with the application of Potassium might be due to crucial role in photosynthesis, respiration, protein synthesis, enzyme activation, water uptake, osmoregulation, growth and yield of plant. Similar results were also reported by Nellore *et al.* (2021) [21]. Another reason, the significant and higher plant height was observed with the application of nutrients via foliar application of Panchagavya 3% accelerates plant growth due to its rich content of beneficial macro and micronutrients, growth hormones, and biofertilizers in liquid form. Additionally, the inclusion of growth enzymes in Panchagavya likely promotes swift cell division and elongation, further fostering rapid plant development. Similar results were also reported by Panchal *et al.* (2017) [22].

3.1.2 Number of nodules/plant

The data revealed that significant and higher no. of nodules (46.20) was recorded in treatment 5 (RDF 100%+ Panchagavya 3%). However, treatment 6 (RDF 100%+ Biodigester 10%), was found to be statistically at par with treatment 5 (RDF 100%+ Panchagavya 3%). Significant and maximum number of nodules/plant was observed with the application of Nitrogen fertilizer in suitable amount as starter can be beneficial to improve nodulation. Similar results were also reported by Namvar *et al*. (2011) [20]. Significant and maximum number of nodules/plant was observed with the application of Phosphorus which gets fixed in the soil due to phosphorus fixation, it is made available to plants by phosphorus solubilizing bacteria, exogenous soil application of phosphorus produces growth promoting materials that helps in proliferation of PSB, PSB provide soil phosphorus to plants and also enhances nodulation. Similar results were also reported by Singh and Singh (2014) [30]. Further, significant and maximum number of nodules/plant was observed with the application of Potassium increases with increase in potassium level. Similar results were also reported by Goud *et al.* (2014) [10]. Another reason, significant and higher number of nodule/plant was observed with the application of Panchagavya 3% revealed higher number of nodules and more efficient root nodules, which resulted into enhanced growth and yield characteristics, ultimately leading to higher chickpea production. Similar results were also reported by Yadav *et al.* (2017) [37].

3.1.3 Number of branches/plant

The data revealed that significant and higher no. of branches (19.53) was recorded in treatment 5 (RDF 100%+ Panchagavya 3%). However, treatment 6 (RDF 100%+ Biodigester 10%), treatment 2 (RDF 75%+ Biodigester 10%), treatment 3 (RDF 75%+ Cow urine 2%), were found to be statistically at par with treatment 5 (RDF 100%+ Panchagavya 3%). Significant and maximum number of branches/plant was observed with the application of Nitrogen the enhanced early vegetative growth in terms of higher dry matter accumulation and vigorous root system resulted in more branches. Similar results were also reported by Nagaraju and Debbarma (2022) [19]. Significant and maximum number of branches/plant was observed with the application of Phosphorus might be due to the fact that phosphorus being an energy essential for almost all metabolic processes, photosynthesis, respiration, cell elongation and cell division, activation of amino acids for synthesis protein and carbohydrate metabolism which ultimately increase all the growth attributes and dry weight of plants. Similar results were also recorded by Singh *et al.* (2010) [29]. Further, significant and maximum number of branches/plant was observed with the application of Potassium which increases the availability of nitrogen and phosphorus wich resulted in better plant growth and more number of branches/plant. Similar results were also recorded by Kurdali *et al.* (2002) [15]. Another reason, the significant and higher number of branches/plant was observed with the application of Panchagavya 3% which contains NPK, some micronutrients and besides this growth regulatory substances such as IAA, Gibberlic acid, cytokinin and essential plant nutrient have also been reported in panchagavya. All these nutreints and PGR's have helped in increase number of branches. Similar results were also recorded by Suresh *et al.* (2011) [38].

3.1.4 Plant dry weight (g)

The data revealed that significant and higher plant dry weight (18.41 g) was recorded in treatment 5 (RDF 100%+ Panchagavya 3%). However, treatment 6 (RDF 100%+ Biodigester 10%), was found to be statistically at par with treatment 5 (RDF 100%+ Panchagavya 3%). Significant and Higher Plant dry weight was observed with the application of Nitrogen fertilizer rates and plant population caused a significant increase in dry weight as either fertilizer level or plant density increased. Similar results were also reported by Roval and Doboriya (2003) [26]. Significant and Higher Plant dry weight was observed with the application of Phosphorus which is an energy bond compound and its major role is transformation of energy essential for almost all metabolic processes photosynthesis, respiration, cell elongation and cell division, activation of amino acids for synthesis of protein and carbohydrate metabolism which ultimately increase all the growth attributes and dry weight of plants. Similar results were also reported by Singh *et al.* (2010) [29]. Further, significant and Higher Plant dry weight was observed with the application of potassium dry matter production which could be attributed to the fact that potassium enhances plant vigour and strengthens the stalk, further resulted in better dry matter production. Similar results were also reported by Kumar and Mehera (2022) [13]. Another reason, the significant and Higher Plant dry weight was observed with the application of Panchagavya 3% observed improvement in dry matter accumulation, chlorophyll content, and nitrogen levels as discussed earlier may be linked to increased yield and yield-related traits. Similar results were also reported by Arun and Debbarma (2022) [2].

3.1.5 Crop Growth Rate (g/m^2/day)

The data revealed that during 60-80 DAS, treatment 5 (RDF 100% + Panchagavya 3%) recorded highest crop growth rate (5.39 g/ m^2 / day), though there was no significant difference among the treatments.

3.1.6 Relative Growth Rate (g/g/day)

The data revealed that during 60-80 DAS treatment 8 (RDF 100%+ Urea 2%) recorded highest Relative growth rate (0.030 g/g/day), though there was no significant difference among the treatments.

3.2 Yield and Yield Parameters

3.2.1 Number of pods/plant

The data revealed that significant and maximum number of pods/plant (54.93) was recorded in treatment 5 (RDF 100%+ Panchagavya 3%). However, treatment 6 (RDF 100%+ Biodigester 10%), was found to be statistically at par with treatment 5 (RDF 100%+ Panchagavya 3%). Significant and maximum number of pods/plant was observed with the application of Nitrogen might be due to the enhanced early vegetative growth in terms of higher dry matter accumulation and vigorous root system resulted in more branches which consequently increased the number of pod bearing branches significantly. Similar result was also reported by Tripathi *et al.* (2013) [34]. Significant and maximum number of pods/plant was observed with the application of Phosphorus might be due to more availability of phosphorus to plant at all growth stages. Similar result were also reported by Susan and Debbarma (2022) [31]. Further, significant and maximum number of pods/plant was observed with the application of potassium wich directly or indirectly improves crop yield through increased photosynthesis, resulted in vigorous growth and consequently produce higher number of pods/plant. Similar result were also reported by Anandamai *et al.* (2021) [39]. Another reason, the significant and maximum number of pods/plant was observed with the application of Panchagavya 3% which is an efficient plant growth stimulant that enhanced the biological efficiency of crops. Similar result were also reported by **Kulkarni *et al.* (2015) [40].**

3.2.2 Number of seeds/pods

The data revealed that significant and maximum number of seeds /pods (1.98) was recorded in treatment 5 (RDF 100%+ Panchagavya 3%). However, treatment 6 (RDF 100%+ Biodigester 10%), was found to be statistically at par with treatment 5 (RDF 100%+ Panchagavya 3%). Significant and maximum number of seeds/pods was observed with the application of Nitrogen might be due to the application of starter Nitrogen fertilizer which produces maximum yield attributes such as pods plant, seeds per pod which ultimately results in higher seed yield. Similar results were also reported by Habbasha *et al.* (2013) [12]. Significant and maximum number of seeds/pods was observed with the application of Phosphorus might be due to more availability of Phosphorus to enhance the crop yield. Similar results were also reported by Pingoliya *et al.* (2015) [25]. Further, significant and maximum number of seeds/pods was observed with the application of potassium might be due to enhanced photosynthetic activity which resulted in more number of seeds per pod. Similar result were also reported by Smiullah & Khan (2003) [7]. Another reason, the significant and maximum number of seeds/pods was observed with the application of Panchagavya 3% observed increase in

reproductive growth viz., pods/plant which is one of the important yield attributes having significant positive correlation with seed & straw yield. Similar result were also reported by Choudary *et al.* (2017) [4].

3.2.3 Seed index (g)

The data revealed that significant and higher seed index (244.15 g) was recorded in treatment 5 (RDF 100%+ Panchagavya 3%). However, treatment 6 (RDF 100%+ Biodigester 10%), was found to be statistically at par with treatment 5 (RDF 100%+ Panchagavya 3%). Significant and higher seed index was observed with the application of Nitrogen might be due to positive correlation with plant height, no. of pods per plant, no of branches per plant which ultimately results in higher seed index. Similar result were also reported by Dar *et al.* (2016) [5]. Significant and higher seed index was observed with the application of phosphorus might be due to the increased phosphorus levels which results in marginal increase in the seed index. Similar result were also reported by Gupta *et al.* (1998) [11]. Further, Significant and higher seed index was observed with the application of potassium might be due to the use of different potassium levels which in turn produces higher seed index. Similar result were also reported by Tembhare *et al.* (2022) [32]. Another reason, the significant and higher seed index was observed with the application of Panchagavya 3% might be due to favourable effect of the cow dung present in the panchagavya which acts as a medium for the growth of beneficial microbes and cow urine provides nitrogen which is essential for crop growth upon fermentation with other in gradients in panchagavya has beneficial effect on growth and yield which ultimetly results in higher seed index. Similar result were also reported by Patil *et al.* (2012) [24].

3.2.4 Seed yield (t/ha)

The data revealed that significant and higher seed yield (2.67 t/ha) was recorded in treatment 5 (RDF 100%+ Panchagavya 3%). However, treatment 6 (RDF 100%+ Biodigester 10%), was found to be statistically at par with treatment 5 (RDF 100%+ Panchagavya 3%). Significant and higher Seed yield was obtained with the application of nitrogen might be due to the photosynthetic activity and increased vegetative growth and yield attributes also improved ultimately increased in seed yield. Similar results were also reported by Togay *et al.* (2005) [33]. Significantly and higher Seed yield was obtained with the application of phosphorus might have due to the cumulative effect of yield attributes and possibly is a result of effective uptake and utilization of nutrient observed through its intensive root system development. Similar results were also reported by Pingoliya *et al.* (2014) [25]. Further, significant and higher Seed yield was obtained with application of potassium, which regulates enzymatic activities, translocation of photosynthates and considerably improves seed yield. Similar results were also reported by Samiullah and Khan (2003) [7]. Another reason, the significant and higher seed yield was observed with the application of Panchagavya 3% might be due to increased synthesis of growth promoting substances which in turn helped in increased growth and yield attributes and finally grain yield. Similar results were also reported by Choudhary *et al.* (2017) [4].

3.2.5 Stover yield (t/ha)

The data revealed that significantly and higher stover yield (4.82 t/ha) was recorded in treatment 5 (RDF 100%+ Panchagavya 3%). However, treatment 6 (RDF 100%+ Biodigester 10%), was found to be statistically at par with treatment 5 (RDF 100%+ Panchagavya 3%). Significant and higher strover yield was observed with the application of nitrogen reported higher fertility level produced significantly higher values of seed and straw yield which results in higher strover yield. Similar results were also observed by Ali *et al.* (2013) [1]. Significant and higher strover yield was observed with the application of phosphorus accelerated the production of photosynthesis and their translocation from source to sink, which ultimately gave the higher value of strover. Similar results were also observed by Lalrinzuali *et al.* (2023) [16]. Further, Significant and higher strover yield was observed with the application of potassium increased all yield attributes and stover yields. Similar results were also observed by Menaria *et al.* (2004) [41]**.** Another reason, the significant and higher strover yield was observed with the application of Panchagavya 3% might be due to the favorable effect on vegetative growth, i.e. plant height and reproductive growth which ultimately gave the higher value of strover yield. Similar results were also observed by Suresh *et al.* (2011) [38].

3.2.6 Harvest index (%)

The data revealed that highest harvest index (35.68%) was recorded in treatment 5 (RDF 100%+ Panchagavya 3%). There was no significant difference among the treatments.

3.3 Economics

The result showed that Maximum gross return (140443.30 INR/ha), Maximum net return (93353.10 INR/ha) and Maximum benefit cost ratio (1.98) was recorded in treatment 5 (RDF 100%+ Panchagavya 3%) as compared to other treatments. Maximum benefit cost ratio was recorded with the application of RDF 100% might be due to higher production because of more availability of nutrient with combine application of nutrient sources which in turn produces maximum gross return, Net return and B:C ratio. Similar results were also reported by Patel and Thanki (2020) [23]. Further the, Maximum gross return, net return and benefit cost ratio was recorded with application of Panchagavya 3% might be due to foliar spray at branching and flowering stage which in turn produces maximum gross return, Net return and B:C ratio. Similar results were also reported by Panchal *et al.* (2017) [22]

Table 1: Effect of Nutrient spray on growth parameters of Chickpea

S. No.	Treatments			80 DAS		60-80 DAS	
		Plant height (cm)	Number of nodules/plant	Number of branches/plant	Plant dry weight (g)	CGR ($g/m^2/day$)	RGR (g/g/day)
	RDF 75%+ Panchagavya 3%	43.72	41.67	17.13	13.04	3.57	0.023
2.	RDF 75%+ Biodigester 10%	42.82	42.40	18.07	13.62	4.05	0.027
3.	RDF 75%+ Cow urine 2%	42.99	41.40	18.00	14.93	4.27	0.024
4.	RDF 75%+ Urea 2%	44.20	42.20	17.60	13.32	3.88	0.025
5.	RDF 100%+ Panchagavya 3%	49.23	46.20	19.53	18.41	5.39	0.025
6.	RDF 100%+ Biodigester 10%	45.24	43.47	18.67	17.14	5.19	0.026
7.	RDF 100%+ Cow urine 2%	43.78	41.13	17.67	15.52	5.01	0.029
8.	RDF 100%+ Urea 2%	42.56	41.47	17.53	15.37	4.97	0.030
9.	Control	40.50	35.67	16.07	13.80	3.83	0.023
	F-test	S	S	S	S	NS	NS
	SEm ±	1.40	1.24	0.59	0.93	1.03	0.0051
	CD (P=0.05)	4.18	3.71	1.77	2.80	--	--

Table 2: Effect of nutrient spray on yield attributes of Chickpea

S.No.	Treatments	Number of pods/plant	Number of Seeds /pod	Seed index (g)	Seed yield (t/ha)	Stover yield (t/ha)	Harvest index (%)
1.	RDF 75%+ Panchagavya 3%	44.84	1.32	21.38	2.32	4.19	35.65
2.	RDF 75%+ Biodigester 10%	43.30	1.38	21.85	2.11	4.02	34.36
3.	RDF 75%+ Cow urine 2%	46.73	1.45	22.24	2.17	4.22	33.95
4.	RDF 75%+ Urea 2%	45.68	1.42	21.24	2.22	4.08	35.27
5.	RDF 100%+ Panchagavya 3%	54.93	1.98	24.41	2.67	4.82	35.68
6.	RDF 100%+ Biodigester 10%	52.96	1.68	23.47	2.55	4.72	35.08
7.	RDF 100%+ Cow urine 2%	43.77	1.38	21.77	2.25	4.24	34.56
8.	RDF 100%+ Urea 2%	44.23	1.41	20.96	2.10	4.40	32.32
9.	Control	37.46	1.16	19.83	2.04	4.13	33.03
	F-test	S	S	S	S	S	NS
	SEm ±	2.55	0.13	0.69	0.09	4.10	1.13
	CD at 5%	7.65	0.38	2.08	0.26	0.30	--

Table 3: Effect of nutrient spray on economics of Chickpea

S. No.	Treatments	Total cost of cultivation (₹/ha)	Gross Return (₹/ha)	Net Returns (₹/ha)	B:C Ratio
1.	RDF 75%+ Panchagavya 3%	45877.38	121735.60	75858.30	1.65
2.	RDF 75%+ Biodigester 10%	45539.88	111093.60	65553.70	1.44
3.	RDF 75%+ Cow urine 2%	44489.88	114701.10	70211.20	1.58
4.	RDF 75%+ Urea 2%	47489.88	116820.20	69330.30	1.46
5.	RDF 100%+ Panchagavya 3%	47090.22	140443.30	93353.10	1.98
6.	RDF 100%+ Biodigester 10%	46752.72	134058.30	87305.60	1.87
7.	RDF 100%+ Cow urine 2%	45702.72	118446.20	72743.50	1.59
8.	RDF 100%+ Urea 2%	48702.72	111829.90	63127.20	1.30
9.	Control	45702.72	108019.30	62316.60	1.36

Conclusion

It is concluded that in Chickpea (treatment 5) with the combination of RDF 100% with foliar application of Panchagavya 3% was observed highest grain yield and benefit cost ratio.

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