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Effect of Mepiquat chloride on yield, fibre quality and biochemical constituents in Bt Cotton

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Abstract

A field experiment was conducted to study the effect of Mepiquat chloride on yield, fibre quality and biochemical constituents in Bt Cotton during kharif, 2023. The use of mepiquat chloride (MC) in Bt cotton (*Gossypium hirsutum*L.) cultivation has increased significantly in recent years. The use of Mepiquat chloride, as a growth regulator, results in higher precocity and lower height and consequently increases yield and reduces crop costs. The objective of this study was to evaluate the effects of Mepiquat chloride @ 45 ppm at square initiation stage and at15 days after first spray, with detopping, further the second and third spray are need based. The continuous application of growth retardant on yield and yield parameters of compact genotypethat the seed cotton yield (kg/ha.) was recorded maximum (1196 kg/ha.) in T7. Mepiquat chloride @45ppm at square initiation and 15 days afterfirst spray and 15 days after second spray (need based) followed by T6-Mepiquat chloride@45ppm at square initiation and 15 days afterfirst spray+Detopping(1159.62kg/ha.)Analysesoffiberqualityincluded:UHML(mm),Uniformity index, Mic (10-6g/in),Tenacity 3.2mm(g/tex), Elongation % andseed and lint index (g).Primary and secondary metabolites level of carbohydrate, protein, tannin, poly phenol, flavonoid and gossypolwas studied. Biochemical estimations in the hybrid due to the chemical sprays showed that the primary and secondary metabolites were significantly reduced in all the treatments compared to the control.

Keywords: Mepiquat chloride, detopping, tannin, protein

Introduction

Cotton is major cash crop of kharif season in India. Growth regulator application in cotton crops causes reduced light interception by the crop, changes the canopy structure, and increases the plant's efficiency by converting the intercepted radiation into dry matter, increasing the translocation of photo assimilates to the reproductive parts in detriment to the vegetative area **(**Gonias *et al*., 2012**)** [4]. However, it can also promote an increase in the number and mass of cotton buds, in addition to increasing the resistance and length of the fibers **(**Ren *et al.,* 2013**;**Gu *et al.,* 2014) [5, 12].Therefore, the objective of this study was to evaluate the effects of MC doses on cotton yield, fiber quality and primary and secondary metabolites level of carbohydrate, protein, tannin, poly phenol, flavonoid and gossypol.

Material And Methods

The experiment was carried out at Agricultural Research Station Hebballi Farm, Dharwad duringkharif2023.Thesoilo fexperimentalfieldwasdeepcottonsoilwithorganiccarbon0.54 %. The experiment was laid out in randomized block design replicated thrice with eight treatments consisting of T1.Control,T2.Detopping, T3.Mepiquat chloride @45ppm at square initiation, T4.Mepiquatchloride@45ppmatsquarein itiation+Detopping,T5.Mepiquatchloride@45ppmat square initiation and 15 days after first spray, T6.Mepiquat chloride @45ppm at square initiation and15daysafterfirstspray+Deto pping,T7.Mepiquatchloride@45ppmatsquareinitiationand 15 days after first spray and 15 days after second spray(need based),T8.Mepiquat chloride @45ppm at square initiation and 15 days after first spray and 15 days after second spray (need based)+Detopping. The Cotton variety RCH-659 was sown at high density i.e., at inter-row spacing of 90 cm and intra-row spacing of 30 cm on 17 July 2023. Recommended cultural practices and plant protection measures were followed throughout the crop growing season. Data on growth parameters and yield attributes were recorded from five tagged plants per plot and calculated in kg ha-[1].

Results and Discussion

Growth and Yield parameters

The plant height (Table no.1) at harvest was maximum in control (103.87 cm.) and was lowest in T6-Mepiquat chloride@45ppm at square initiation and 15 days after first

spray + Detopping ie., (52.27). Number of sympodia were maximum in control (22.00) which is on par with T5-Mepiquat chloride @45ppm at square initiation and 15 days afterfirst spray (21.20) and T3-Mepiquat chloride @45ppm at square initiation (21.13). The lowest number of sympodia (14.27) is recorded in T6-Mepiquat chloride @45ppm at square initiation and 15 days after first spray + Detopping. Where as the no. of bolls per sq. meter was maximum (72.04) in T6-Mepiquat chloride @45ppm at square initiation and 15 days after first spray + Detopping followed by T4- Mepiquat chloride @45ppm at square initiation + Detopping (65.12). The boll weight per plant and seed cotton yield (kg/ha.) was maximum (81.23gm.) and (1196.36kg/ha.) in T7-Mepiquat chloride@45ppm at square initiation and 15 days afterfirst spray and 15 days after second spray (need based) and lowest boll weightand seed cotton yield (kg/ha.) was recorded (32.09 gm.) and (582.01 kg/ha) in control. Followed by (1159.62 kg/ha.) cotton yield recorded in T6-Mepiquat chloride @45ppm at square initiation and 15 days after first spray + Detopping**.**

Jadhav*etal*(2020)reportedthatforhighestseedcottonyieldandh ighereconomicreturns de-topping at 75 DAS or spraying of Mepiquate Chloride 5% AS @ 250 ppm (25 ml /10 l water) at 75 DAS is recommended for hirsutum cotton under high density planting. Brijal *et al*.,(2021) [2] reported marked effect of mepiquat chloride treatments on seed yield and stalk yield (Kg ha-1). Three sprays of MC @ 0.4 ml/lit at 45, 60 and 75 DAS, registered significant higherseedcotton yield than rest of the treatments and recorded 28.8% higher seed cotton yield over control. However Tung S A.(2018) [13] reported that increased accumulation of sucrose, hexose and starch in the leaf with application of MC diminished the photosynthesis and thus could explained the yield loss. Therefore MC application is not necessary late sown cotton plant.

Table 1: Effect of application of growth retardantand detopping on growth and yield of compact genotype

Treatments	Plantheightat harvest(cm.)	No.of sympodia	No. of monopodia	No.ofBollsper sq.mt.	Bollweightper plant (gm.)	Seedcotton yield (kg/ha.)
T1.Control	103.87	22.00	1.30	43.40	32.09	582.01
T2.Detopping	53.13	15.93	1.10	53.76	48.10	704.00
T3.Mepiquatchloride@45ppmatsquare initiation	83.53	21.13	1.20	46.88	55.14	850.98
T4.Mepiquatchloride@45ppmatsquare initiation +Detopping	66.40	16.40	1.00	65.12	63.73	924.46
T5.Mepiquatchloride@45ppmatsquare initiation and 15 days afterfirst spray	80.13	21.20	1.30	68.28	63.87	990.77
T6.Mepiquatchloride@45ppmatsquare initiation and 15 days afterfirst spray +Detopping	52.27	16.27	1.30	72.04	73.59	1159.62
T7.Mepiquat chloride@45ppm at square initiationand15daysafterfirstsprayand 15 days after second spray (need based)	57.13	21.47	1.10	69.64	81.23	1196.36
T8.Mepiquat chloride@45ppm at square initiationand15daysafterfirstsprayand 15 days after second spray (need based)+Detopping	54.53	16.47	1.30	70.74	71.07	1023.08
Mean	70.88	18.85	1.20	61.28	61.10	948.94
S.Em. ±	3.99	1.36	0.04	1.86	0.65	28.30
CD @5%	12.1	4.11	0.11	5.6	1.79	80.7

Fibre quality parameters

Table no 2. indicates the data on continuous application of growth retardant on quality parametersof compact genotypethatthe seed index and lint index was recorded maximum (10.53 and 6.31g) in T3.Mepiquat chloride@45ppm at square initiation and lowest seed index was recorded in T5.Mepiquat chloride @ 45ppm at square initiation and 15 days afterfirst spray(9.99) and lowest lint index (5.69) was recorded in treatments T4.Mepiquat chloride@45ppm at square initiation + Detopping and T7.Mepiquat chloride @45ppm at square initiation and 15 days afterfirst spray and 15 days after second spray (need based). The upper half mean leangth (mm) was recorded maximum in T2.Detopping (29.90) and lowest upper half mean leangth (mm) was recorded in treatments T6.Mepiquat chloride @45ppm at square initiation and 15 days afterfirst spray + Detopping (27.60). The Uniformity index is maximum in treatment T1control, T2detopping and T5.Mepiquat chloride @45ppm at square initiation and 15 days afterfirst spray (83.00) and lowest recorded in T6.Mepiquat chloride @45ppm at square initiation and 15 days afterfirst spray + Detopping and T8.Mepiquat chloride @45ppm at square initiation and 15 days afterfirst spray and 15 days after second spray (need based)+ Detopping (81.00). Micronaire (10-6g/in)andTenacity3.2mm(g/tex)wasmaximuminT4.Mepiquatchloride@45ppmatsquare initiation + Detopping (3.70 and 28.70) respectively and the lowest values recorded in T8.Mepiquat chloride@45ppm at square initiation and 15 days afterfirst spray and 15 days after second spray (need based)+Detopping (3.20 and 26.40) respectively. Kerby (1985) [9] reported that fibre strength was increased slightly by MC, in some experiment but not in others. The magnitude of treatment difference not large enough to be major economic importance. A similar small increase was noted in micronaire when plots were treated with MC.Treatment had no effect on fibre length and fibre elongation.Jonathan and Alexander (2006) [8] reported Lint yield, gin turnout, upper half mean staple length, fiber strength, uniformity, and elongation were not influenced by plant population or mepiquat chloride application. Luo *et al*

(2023) [10] reported increasing PPD coupled with MC application improves cotton yield by enhancing leaf carbohydrate production and utilization efficiency and delaying leaf senescence.

Table 2: Effect of application ofmepiquat chloride and detopping on qualityparameters in cottongenotype

Treatments	Seed Index(g)	Lint Index(g)	UHML(mm)	Uniformity index	Mic(10-6g/in)	Tenacity 3.2mm(g/tex)	Elongation %
T1.Control	10.17	6.17	29.50	83.00	3.40	28.70	4.10
T2.Detopping	10.40	6.07	29.90	83.00	3.40	28.60	4.10
T3.Mepiquatchloride@45ppmatsquare initiation	10.53	6.31	28.20	82.00	3.40	28.00	4.00
T4.Mepiquatchloride@45ppmatsquare initiation +Detopping	10.07	5.69	29.00	82.00	3.70	28.70	4.00
T5.Mepiquatchloride@45ppmatsquare initiation and 15 days afterfirst spray	9.99	5.89	29.80	83.00	3.50	28.70	4.10
T6.Mepiquatchloride@45ppmatsquare initiation and 15 days afterfirst spray +Detopping	10.27	6.10	27.60	81.00	3.30	26.50	4.00
T7.Mepiquat chloride@45ppm at square initiationand15daysafterfirstsprayand 15 days after second spray (need based)	10.33	5.69	28.60	82.00	3.40	27.90	4.00
T8.Mepiquat chloride@45ppm at square initiationand15daysafterfirstsprayand 15 days after second spray (need based)+Detopping	10.43	5.86	27.70	81.00	3.20	26.40	4.00
Mean	10.25	5.99	28.94	82.29	3.44	28.16	4.04
S.Em. ±	0.11	0.01	1.38	3.93	0.16	1.34	0.19
CD @5%	0.33	0.03	4.19	NS	0.5	NS	NS
CV	1.83	0.2	8.31	8.29	8.33	8.32	8.29

Biochemical constituents

The cotton genotype RCH-659 was investigated for canopy management by performing detopping and by foliar application of growth retardant MC at different time interval with detopping. Biochemical estimations in the hybrid due to the chemical sprays showed that the primary and secondary metabolites were significantly reduced in all the treatments compared to the control (Table 3).

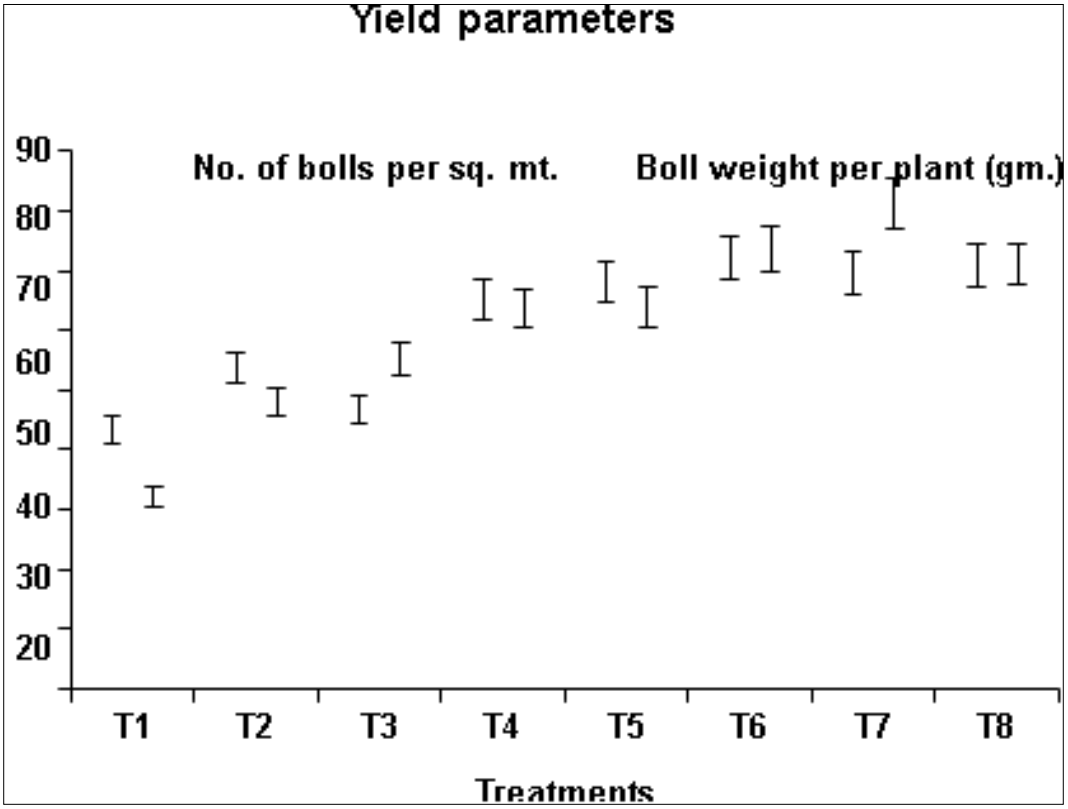
The cotton genotype RCH-659 was investigated for canopy management by performing detopping and by foliar application of growth retardant. Biochemical constituents were estimated in RCH-659, and the results indicated that the primary (carbohydrates and total soluble proteins) and secondary metabolites (tannins, phenolos, flavonoids and gossypol) significantly reduced in all the treatments compared to the control (Table 3). These results are in contrary to the earlier reports that mepiquat chloride induced the production of total phenols, flavonoids and tannins (Zhou *et al*., 2019) [14] and increased the carbohydrate content in cotton (Hummel *et al.,* 2010) [7]. Mepiquatchlorideinfluencestheyieldanditsbiochemicalconstituentsinconsistentlyincotton.

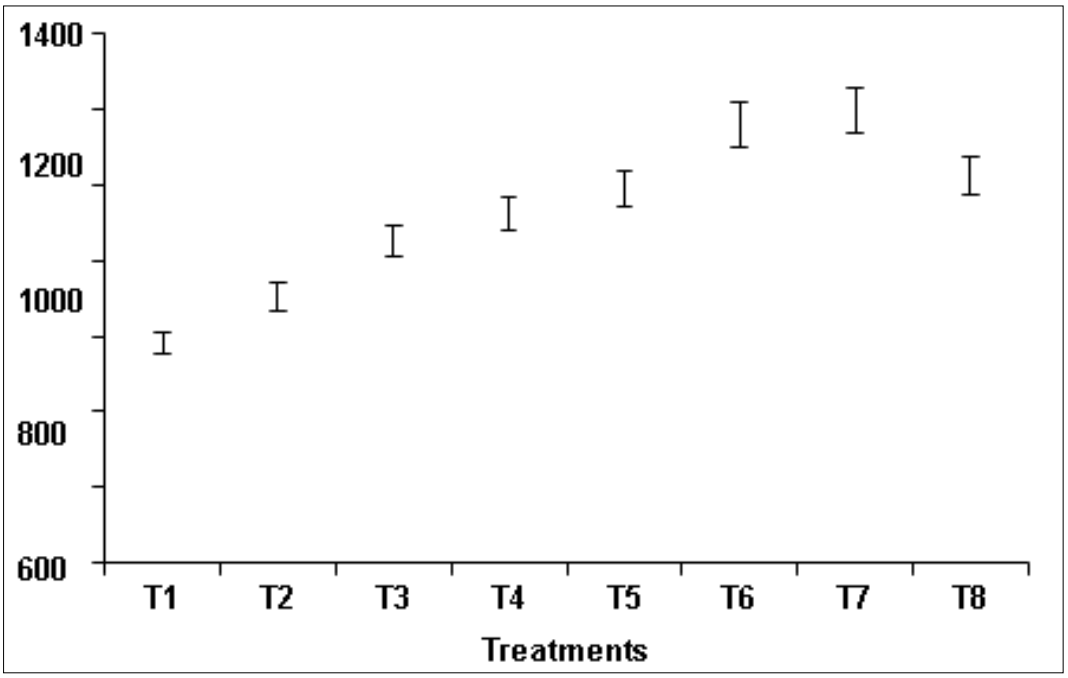
Both increased and reduced yield up on mepiquat chloride application have been reported earlier (Gwathmey and Clement, 2010; Mao *et al*., 2015; Cook and Kennedy, 2000; Tung *et al*., 2018) [3, 6, 11, 6, 13]. Tung *et al.* (2018) [13] have proposed that mepiquat chloride did not favoured photosynthesis, carbohydrate metabolism and lint yield in late planted cotton under high density planting. Supporting to this result the experiment period ie., from July to January 2023-24 the rainfall received washardly 464.2 mm 49 % less rainfall than normal.

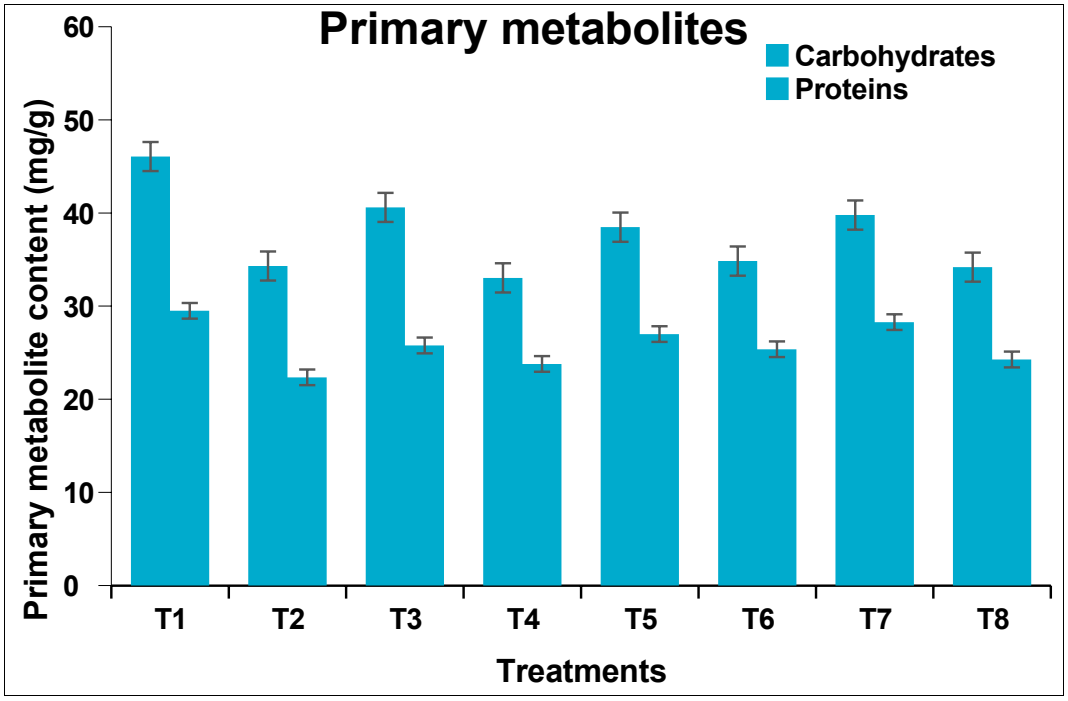
Table 3: Effectofgrowthretardantanddetoppingonproductionofprimaryandsecondarymetabolites in cotton.

Treatments	Carbohydrates	Proteins	Tannins	Polyphenols	Flavonoids	Gossypol
	(mg/g fr. wt.)					
T1.Control	46.06	29.50	4.04	4.17	9.89	1.90
T2.Detopping	34.31	22.35	2.62	2.62	7.49	1.19
T3.Mepiquathloride@45ppm at square initiation	40.60	25.78	3.43	3.66	8.75	1.66
T4.Mepiquat hloride@45ppm at square initiation +Detopping	33.03	23.79	2.48	2.71	7.77	1.23
T5.Mepiquat chloride@45ppm atsquareinitiationand15days afterfirst spray	38.48	27.00	2.97	3.73	8.66	1.64
T6.Mepiquat chloride@45ppm atsquareinitiationand15days afterfirst spray +Detopping	34.84	25.37	2.51	2.54	7.12	1.26
T7.Mepiquat chloride@45ppm atsquareinitiationand15days afterfirst	39.78	28.28	3.49	3.76	8.81	1.71

spray and 15 days after second spray (need based)						
T8.Mepiquat chloride@45ppm atsquareinitiationand15days afterfirst spray and 15 days after second spray (need based)+Detopping	34.19	24.27	2.65	2.73	7.77	1.24
Mean	37.66	25.79	3.02	3.24	8.28	1.48
SEM	1.235	1.698	0.277	0.258	0.629	0.118
CD (5%)	3.781	5.199	0.848	0.791	1.926	0.360







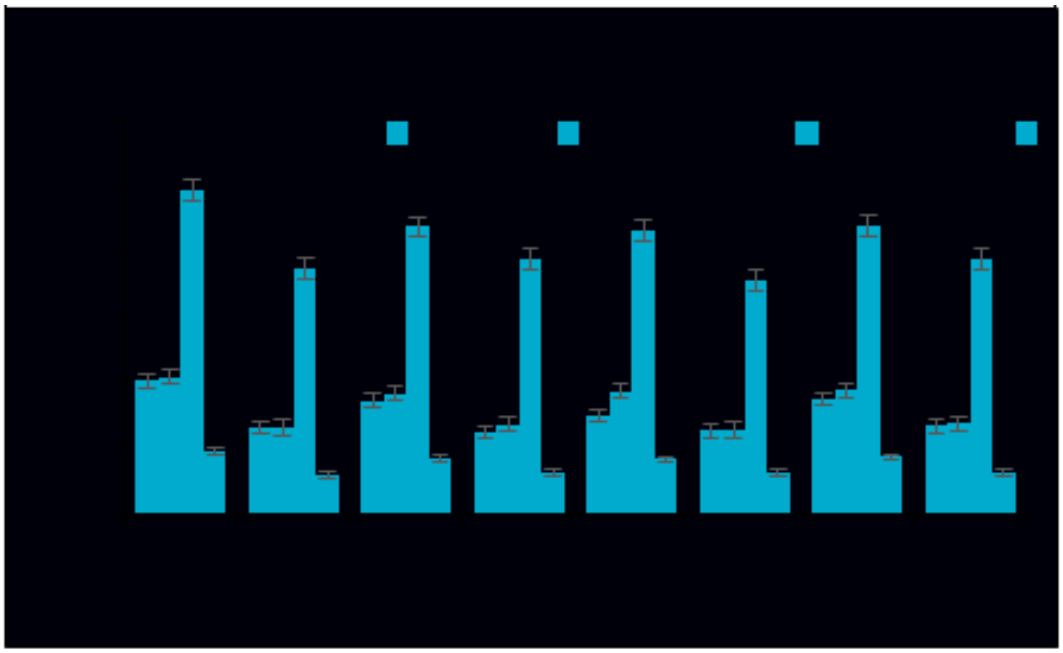


Fig.2: Effect of growth retardant and detopping on production of primary and secondary metabolites in cotton

Conclusion

Mepiquat chloride@45ppm at square initiation and 15 days afterfirst spray and 15 days after second spray (need based) treatmenthaveeffect on seed cottonyield (Kg ha-1). The magnitude of treatment difference not large enough to be major economic importance in fibre quality assessment however, small increase was noted in micronaire and upper half mean length(UHML) when plots were treated with MC. Biochemical estimations in the hybrid due to the chemical sprays showed that the primary and secondary metabolites were significantlyreduced in all the treatments compared to the control due to late sowing cotton under high density planting.

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