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Jyoti Kumari

Department of Agronomy,
 Ranchi Agriculture College,
 Birsa Agricultural University,
 Kanke, Ranchi, Jharkhand,
 India

Sheela Barla

Department of Agronomy,
 Ranchi Agriculture College,
 Birsa Agricultural University,
 Kanke, Ranchi, Jharkhand,
 India

Kirti Kumud Binjha

Department of Agronomy,
 Ranchi Agriculture College,
 Birsa Agricultural University,
 Kanke, Ranchi, Jharkhand,
 India

Shivam Kumar Singh

Department of Agronomy,
 Ranchi Agriculture College,
 Birsa Agricultural University,
 Kanke, Ranchi, Jharkhand,
 India

Shusama Majhi

Department of Agronomy,
 Ranchi Agriculture College,
 Birsa Agricultural University,
 Kanke, Ranchi, Jharkhand,
 India

Corresponding Author:**Kirti Kumud Binjha**

Department of Agronomy,
 Ranchi Agriculture
 College, Birsa Agricultural
 University, Kanke, Ranchi,
 Jharkhand, India

Effect of integrated weed management on weed dynamics and economics in finger millet

Jyoti Kumari¹, Sheela Barla², Kirti Kumud Binjha³, Shivam Kumar Singh⁴, Shusama Majhi⁵

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ABSTRACT

The experiment was conducted at Birsa Agricultural University, Ranchi during kharif season, 2023. This experiment was conducted to evaluate the effect of integrated weed management practices on weeds dynamics in finger millet. The experiment was laid out in Randomized Block Design with 14 treatments viz. oxyfluorfen 50 g/ha as PPI & PE, bispyribac sodium 15 g/ha & 20 g/ha (20 DAS), oxyfluorfen 50 g/ha (PPI) + bispyribac sodium 15 g/ha and 20 g/ha (20 DAS), oxyfluorfen 50 g/ha (PE) + bispyribac sodium 15 g/ha and 20 g/ha (20 DAS), oxyfluorfen 50 g/ha as PPI & PE + hand weeding (20 DAS), bispyribac sodium 15 g/ha and 20 g/ha (20 DAS) + hand weeding (40 DAS), two hand weeding (20 & 40 DAS) and weedy check. The recommended dose of fertilizer was 40:30:20 kg N: P₂O₅: K₂O/ha and variety BBM-10 was taken for the experiment. Results illustrated that two hand weeding (20 & 40 DAS) recorded reduced broad leaf, grassy, sedges, total weed density total weed dry weight with highest weed control efficiency at all crop growth stages resulting maximum grain yield and economic returns and was at par with application of oxyfluorfen 50 g/ha (PE) + hand weeding (20 DAS) and oxyfluorfen 50 g/ha (PPI) + hand weeding (20 DAS). The highest B:C ratio (3.62) and lowest weed index (3.67 %) was recorded with oxyfluorfen 50 g/ha (PE) + hand weeding (20 DAS).

Keywords: Oxyfluorfen, Bispyribac sodium, Finger millet, Integrated weed management, Weed dynamics

Introduction

Finger millet (*Eleusine coracana* L.) is minor millet with several edible and industrial uses. It has several vernacular names all over the world, but it is known as ragi in India. India continued to be the major producer of finger millet with cultivated area of 12.48 lakh ha and average yields of 19.77 lakh tonnes/ha, during 2024-25 (DA & FW, GoI, 2024-25) [1] and is one of the major staple foods of farming communities in some of the Indian states. Despite all the facts, both the growth and productivity of the crop are in declining trend due to several biotic and abiotic stresses. Rao *et al.* (2015) [2] revealed that in un-weeded plot, weed competition causes significant reduction in finger millet yield by 50-70%. *Echinochloa colona*, *Digitaria sanguinalis*, *Cynodon dactylon*, *Panicum miliacea*, *Dactyloctenium aegyptium*, *Cyperus rotundus*, *Amaranthus viridis*, *Eleusine indica*, *Celosia argentea*, *Commelina benghalensis*, *Euphorbia geniculata* etc. are the major weed species found in finger millet crop.

Materials and Methods

A field experiment was conducted at Agronomical Research Farm, Birsa Agricultural University, Ranchi during Kharif 2023 under rainfed medium land condition in sandy loamy soil having pH 5.54, available nitrogen (232.12 kg/ha), phosphorus (36.21 kg/ha) and potassium (136.24 kg/ha). Total quantity of phosphorus and potassium were applied as basal, while nitrogen was applied as two splits i.e., 50% as basal and 50% at 30 DAS. The experiment was laid out in a randomized block design with three replication having 14 treatments comprising of hand weeding, pre-plant incorporation and pre-emergence application of oxyfluorfen 50 g/ha, post emergence application of bispyribac sodium 15 g/ha and 20 g/ha and their combination with hand weeding. Spraying was done by flat fan nozzle at spray volume of 500 litre/ha. The required quantity of herbicide was dissolved in measured quantity of water and sprayed uniformly as per the treatment.

The data on weed density and dry weight was transformed to square root transformation $\sqrt{X + 0.5}$ to normalize their distribution before analysis. The experimental data were subjected to standard statistical analysis.

Result and Discussion

Weed density at 30, 60 and 90 DAS

In the experimental field the relative weed density of major weed species as compared to total weeds present in the plots were as follows: *Cyperus rotundus* L. 36.81%, *Digitaria sanguinalis* 17.95%, *Commelina nodifolia* L. 11.71%, *Amaranthus viridis* L. 8.90%, *Ageratum conyzoides* L. 4.41% and *Commelina benghalensis* L. 3.57%. Mukherjee *et al.* (2008) [3], Haider *et al.* (2007) [4], Upasani *et al.* (2012) [5] and Raj *et al.* (2013) [6] have also reported *Commelina benghalensis* L. as dominant broad leaved weed associated in the experimental field, where as Upasani *et al.* (2012) [5] and

Raj *et al.* (2013) [6] observed *Cyperus* species as dominant sedges in the experimental field. The application of pre-emergence herbicide even though had suppressive effect on grasses and broad leaved weeds, but the effect was acceptable up to initial 15-20 days. These results are in accordance with the Hatti *et al.* (2016) [7].

Application of oxyfluorfen at 50 g/ha (PE) + hand weeding recorded reduced weed density during all the crop growth stages i.e., 89.68%, 86.10%, 64.58%, and 79.43% reduction in broad leaf, grassy, sedge, and total weeds at 30 DAS and 80.97 %, 88.15 %, 88.05 %, and 85.77 %, at 60 DAS, respectively, 84.69 %, 89.07 %, 81.82 %, and 86.04 % at 90 DAS as compared to the weedy check. (Table 1)

Table 1. Weed species observed in the experimental field

Common Name	English Name	Botanical Name	Family	No./ m ²	Relative Weed Density (%)
Broad-leaves					
Mahkowa	Day flower	<i>Commelina benghalensis</i> L.	Commelianaceae	151	3.57
Kena	Tropical ageratum	<i>Ageratum conyzoides</i> L.	Asteraceae	63	4.41
Bas-kena	Common day flower	<i>Commelina nodifolia</i> L.	Commelianaceae	167	11.71
Gehnari	Wild amaranth	<i>Amaranthus viridis</i> L.	Amaranthaceae	127	8.90
Bangajar	Swine-cress	<i>Coronopus didymus</i> L.	Brassicaceae	14	0.98
Hazar dhaniya	Gripe weed	<i>Phyllanthus niruri</i> F.	Euphorbiaceae	10	0.70
Grassy					
Sawan	Barnyard grass	<i>Echinochloa crusgalli</i> L. P. Beauv	Poaceae	34	2.38
Makra	Crow foot grass	<i>Dactyloctenium aegyptium</i> L.	Poaceae	42	2.94
Banmadua	Goose grass	<i>Eleusine indica</i> Gaerts.	Poaceae	35	2.45
Dub	Bermuda grass	<i>Cynodon dactylon</i> Pers.	Poaceae	37	2.59
Jungli Sorghum	Johnson grass	<i>Sorghum halepense</i> L. Pers.	Poaceae	15	1.05
Chatni makra	Hairy finger grass	<i>Digitaria sanguinalis</i>	Poaceae	256	18.00
Sedges					
Motha	Purple nut sedge	<i>Cyperus rotundus</i> L.	Cyperaceae	525	36.81
Jungli naizar	Electric daisy	<i>Spilanthus acmella</i>	Asteraceae	50	3.50
Total				1426	100

Weed dry weight and weed control efficiency at 30, 60 and 90 DAS

Weed management practices oxyfluorfen 50 g/ha (PE) + hand weeding at 20 DAS significantly reduced dry matter of all categories of weeds i.e., 74.01, 109.52 and 79.52 g/m² at 30, 60 and 90 DAS re-

spectively, were Application of two hand weeding at 20 and 40 DAS recorded highest weed control efficiency 60.91 %, 79.52 % and 84.01% at 30, 60 and 90 DAS respectively, and was at par with oxyfluorfen 50 g/ha (PE) + hand weeding at 20 DAS. The weed control efficiency is inversely related to dry matter production of weeds.

Table 2: Weed density of broad leaf, grassy and sedges as influenced by different weed control treatments

Tr. no.	Treatments	30 DAS				60 DAS				90DAS			
		BL	Grasses	Sedges	Total	BL	Grasses	Sedges	Total	BL	Grasses	Sedges	Total
T ₁	Oxy50g/ha (PPI)	9.69 (93.33)	19.05 (362.67)	18.12 (328.00)	28.01 (784.00)	13.43 (180.00)	17.60 (309.33)	10.92 (118.67)	24.67 (608.00)	13.43 (180.00)	16.42 (269.33)	8.28 (68.00)	22.75 (517.33)
T ₂	Oxy 50g/ha (PE)	7.78 (60.00)	16.94 (286.67)	16.55 (273.33)	24.91 (620.00)	13.38 (178.67)	17.06 (290.67)	10.79 (116.00)	24.20 (585.34)	13.13 (172.00)	16.18 (261.33)	7.43 (54.67)	22.10 (488.00)
T ₃	Bis Na 15g/ha (20 DAS)	11.74 (137.33)	22.25 (494.67)	19.15 (366.67)	31.60 (998.67)	16.94 (286.67)	18.87 (356.00)	12.18 (148.00)	28.12 (790.67)	15.55 (241.33)	17.37 (301.33)	11.51 (132.00)	25.98 (674.66)
T ₄	Bis Na 20g/ha (20 DAS)	10.61 (112.00)	20.14 (405.33)	18.27 (333.33)	29.17 (850.67)	13.73 (188.00)	17.90 (320.00)	11.27 (126.67)	25.20 (634.67)	13.97 (194.67)	17.25 (297.33)	7.86 (61.33)	23.53 (553.33)
T ₅	Oxy 50g/ha (PPI) + Bis Na 15g/ha (20 DAS)	7.52 (56.00)	16.74 (280.00)	15.63 (241.33)	24.09 (580.00)	12.98 (168.00)	15.68 (245.33)	7.69 (58.67)	21.73 (472.00)	10.73 (114.67)	15.20 (230.67)	9.62 (92.00)	20.92 (437.33)
T ₆	Oxy 50g/ha (PPI) + Bis Na 20g/ha (20 DAS)	6.96 (48.00)	16.30 (265.33)	15.55 (244.00)	23.55 (554.67)	12.72 (161.33)	15.07 (226.67)	7.30 (52.78)	21.00 (440.78)	8.82 (77.33)	13.68 (186.67)	9.40 (88.00)	18.77 (352.00)
T ₇	Oxy 50g/ha (PE) + Bis Na 15g/ha (20 DAS)	6.87 (46.67)	14.67 (214.67)	14.89 (221.33)	21.98 (482.67)	11.39 (129.33)	14.20 (201.33)	7.15 (50.67)	19.54 (381.34)	8.11 (65.33)	12.98 (168.00)	8.74 (76.00)	17.60 (309.33)
T ₈	Oxy 50g/ha (PE) + Bis Na 20g/ha (20 DAS)	6.67 (44.00)	12.67 (160.00)	14.71 (216.00)	20.50 (420.00)	11.22 (125.33)	13.09 (171.00)	7.06 (49.33)	18.60 (345.66)	7.34 (53.33)	11.57 (133.33)	8.11 (65.33)	15.89 (252.00)
T ₉	Oxy 50g/ha (PPI) + HW (20 DAS)	5.08 (25.33)	10.54 (110.67)	12.56 (157.33)	17.14 (293.33)	9.41 (88.00)	10.22 (104.00)	5.46 (29.33)	14.89 (221.33)	6.77 (45.33)	6.15 (37.33)	5.34 (28.00)	10.54 (110.67)
T ₁₀	Oxy 50g/ha (PE)+ HW (20 DAS)	4.67 (21.33)	8.67 (74.67)	11.68 (136.00)	15.24 (232.00)	7.95 (62.67)	7.43 (54.67)	5.08 (25.33)	11.96 (142.67)	6.57 (42.67)	6.04 (36.00)	5.21 (26.67)	10.29 (105.33)
T ₁₁	Bis Na 15g/ha (20 DAS) + HW (40 DAS)	6.15 (37.330)	12.51 (156.00)	14.25 (202.67)	19.91 (396.00)	10.48 (109.33)	12.72 (161.33)	6.87 (46.67)	17.83 (317.33)	7.15 (50.67)	9.05 (81.33)	8.03 (64.00)	14.02 (196.00)
T ₁₂	Bis Na 20g/ha (20 DAS) + HW (40 DAS)	5.34 (28.00)	12.02 (144.00)	14.06 (197.33)	19.23 (369.33)	9.62 (92.00)	10.35 (106.67)	6.57 (42.67)	15.55 (241.34)	6.96 (48.00)	6.67 (44.00)	5.70 (32.00)	11.16 (124.00)
T ₁₃	Two HW (20 & 40 DAS)	3.54 (12.00)	7.06 (49.33)	11.85 (140.00)	14.21 (201.33)	6.15 (37.33)	5.82 (33.33)	4.06 (16.00)	9.33 (86.67)	5.82 (33.33)	5.70 (32.00)	4.95 (24.00)	9.48 (89.33)
T ₁₄	Weedy check	14.39 (206.67)	23.19 (537.33)	19.61 (384.00)	33.59 (1128.00)	18.16 (329.33)	21.49 (461.33)	14.57 (212.00)	31.67 (1002.67)	16.71 (278.67)	18.16 (329.33)	12.13 (146.67)	27.48 (754.67)
	SE m ±	0.58	1.23	0.70	1.14	0.75	0.70	0.47	0.92	0.42	0.61	0.45	0.85
	CD (P = 0.05)	1.68	3.59	2.03	3.33	2.18	2.05	1.36	2.67	1.22	1.76	1.32	2.47
	CV%	13.12	14.06	7.82	8.59	10.87	8.65	9.71	7.84	7.21	8.52	9.82	8.23

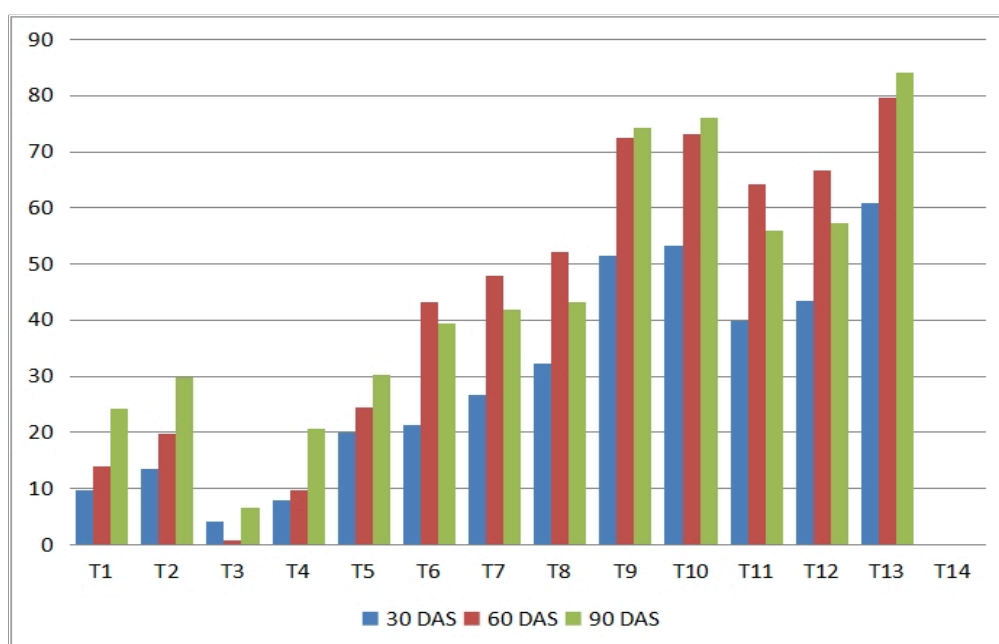
* Data in parentheses are original values subjected to square root $\sqrt{X + 0.5}$ transformation

* BL- Broad leaf

Table 3. Effect of integrated weed management on weed dry weight (g/m²) and weed control efficiency (%) in finger millet

Tr. no.	Tr. Name	Weed dry weight (g/m ²)			Weed control efficiency (%)		
		30 DAS	60 DAS	90 DAS	30 DAS	60 DAS	90 DAS
T ₁	Oxy 50g/ha (PPI)	11.45 (131.01)	18.35 (336.61)	15.83 (250.76)	9.74	13.99	24.26
T ₂	Oxy 50g/ha (PE)	11.22 (125.47)	17.73 (313.97)	15.26 (232.56)	13.56	19.77	29.75
T ₃	Bis Na 15g/ha (20 DAS)	11.81 (139.17)	19.70 (387.85)	17.60 (309.33)	4.12	0.89	6.56
T ₄	Bis Na 20g/ha (20 DAS)	11.59 (133.76)	18.80 (353.15)	16.14 (262.75)	7.84	9.76	20.64
T ₅	Oxy 50g/ha (PPI) + Bis Na 15g/ha (20 DAS)	10.79 (116.04)	17.17 (295.45)	15.21 (231.07)	20.05	24.50	30.21
T ₆	Oxy 50g/ha (PPI) + Bis Na 20g/ha (20 DAS)	10.70 (114.32)	14.93 (222.39)	14.18 (200.73)	21.24	43.17	39.37
T ₇	Oxy 50g/ha (PE) + Bis Na 15g/ha (20 DAS)	10.34 (106.47)	14.27 (203.46)	13.89 (192.45)	26.65	48.01	41.87
T ₈	Oxy 50g/ha (PE) + Bis Na 20g/ha (20 DAS)	9.94 (98.27)	13.71 (187.41)	13.74 (188.29)	32.30	52.11	43.13
T ₉	Oxy 50g/ha (PPI) + HW (20 DAS)	8.64 (74.16)	11.09 (122.51)	11.62 (134.75)	51.43	72.40	74.22
T ₁₀	Oxy 50g/ha (PE) + HW (20 DAS)	8.61 (74.01)	10.47 (109.52)	8.93 (79.52)	53.32	73.23	75.98
T ₁₁	Bis Na 15g/ha (20 DAS) + HW (40 DAS)	9.36 (87.17)	11.87 (140.48)	12.10 (146.03)	39.94	64.10	55.93
T ₁₂	Bis Na 20g/ha (20 DAS) + HW (40 DAS)	9.20 (84.33)	11.24 (130.47)	11.90 (141.37)	43.34	66.66	57.30
T ₁₃	Two HW (20 & 40 DAS)	7.52 (56.73)	8.23 (68.84)	7.02 (49.00)	60.91	79.52	84.01
T ₁₄	Weedy check	12.03 (145.15)	19.74 (391.35)	18.20 (331.07)	0.00	0.00	0.00
	SE m ±	0.54	0.92	0.98	1.36	2.92	3.42
	CD (<i>p</i> = 0.05)	1.56	2.68	2.86	3.96	8.50	9.95
	CV%	9.10	10.79	12.44	8.60	12.48	14.23

*Data in parenthesis (original value) was subjected to $\sqrt{X + 0.5}$ transformation

**Figure 1.** Weed control efficiency of finger millet as influenced by weed control methods

Yield and economics of finger millet

Managing weeds enhanced the yield and economic return as compared to weedy check. Among integrated weed management, application of oxyfluorfen 50 g/ha (PE) + hand weeding at 20 DAS recorded

maximum grain yield (3066 kg/ha), straw yield (5281 kg/ha), WI 3.67%, net return (₹87049/ha) and B:C ratio (3.62) with minimum WI i.e., 3.67%. This might have resulted from effective suppression of weed growth.

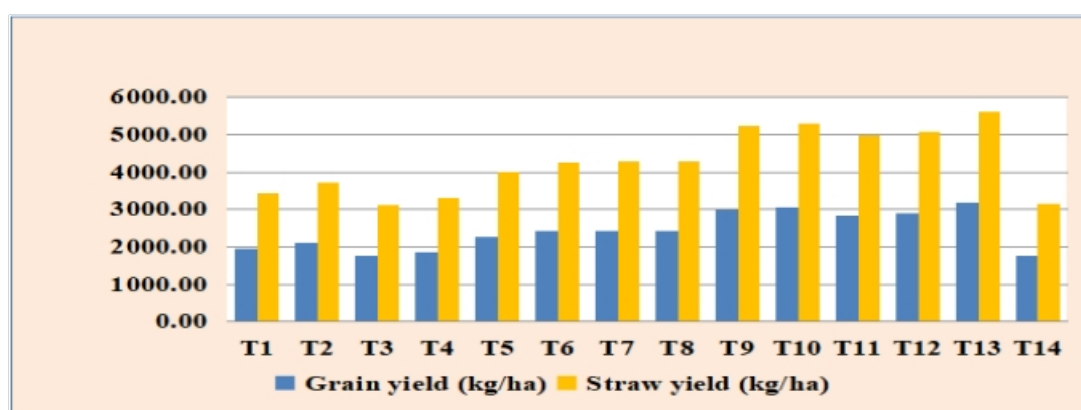


Figure 2. Grain yield and straw yield of finger millet as influenced by weed control methods

Conclusion

Based on the one-year experimentation it can be concluded that among herbicidal treatments application of oxyfluorfen 50 g/ha (PE) + hand weeding (20 DAS) has been identified as most effective for

suppressing broad-leaved, grassy weeds and sedges weeds and fetching more yield and economic returns of finger millet.

Table 4. Effect of integrated weed management on yield, harvest index, weed index and economics attributes in finger millet

Tr. no.	Treatments Name	Grain yield (kg/ha)	Straw yield (kg/ha)	WI (%)	Economics			
					Cost of Cultivation (₹/ha)	Gross return (₹/ha)	Net return (₹/ha)	B:C
T ₁	Oxy50g/ha (PPI)	1947	3444	38.80	26213	76539	50326	2.92
T ₂	Oxy 50g/ha (PE)	2102	3713	0.34	26213	82624	56411	3.15
T ₃	Bis Na 15g/ha (20 DAS)	1763	3122	44.50	26238	69320	43082	2.64
T ₄	Bis Na 20g/ha (20 DAS)	1867	3299	13.16	26263	73411	47148	2.80
T ₅	Oxy 50g/ha (PPI) + Bis Na 15g/ha (20 DAS)	2265	3998	28.82	27687	89038	61351	3.22
T ₆	Oxy 50g/ha (PPI) + Bis Na 20g/ha (20 DAS)	2410	4256	24.22	27711	94739	67028	3.42
T ₇	Oxy 50g/ha (PE) + Bis Na 15g/ha (20 DAS)	2424	4281	23.90	27687	95305	67618	3.44
T ₈	Oxy 50g/ha (PE) + Bis Na 20g/ha (20 DAS)	2434	4294	23.39	27711	95665	67954	3.45
T ₉	Oxy 50g/ha (PPI) + HW (20 DAS)	2977	5246	6.46	33213	117009	83796	3.52
T ₁₀	Oxy 50g/ha (PE)+ HW (20 DAS)	3066	5281	3.67	33213	120263	87049	3.62
T ₁₁	Bis Na 15g/ha (20 DAS) + HW (40 DAS)	2824	4978	11.28	33238	110994	77756	3.34
T ₁₂	Bis Na 20g/ha (20 DAS) + HW(40 DAS)	2888	5091	9.19	33263	113526	80264	3.41
T ₁₃	Two HW (20 & 40 DAS)	3183	5604	0.00	38765	125104	86339	3.23
T ₁₄	Weedy check	1754	3164	44.70	24765	69098	44333	2.79
	SE m ±	101.53	177.12	1.45	-	3980.69	3980.69	0.13
	CD (<i>p</i> = 0.05)	295.15	514.90	4.23	-	11571.69	11571.70	0.38
	CV%	7.26	7.18	12.97	-	7.24	10.49	7.13

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