



# Compatibility of Herbicides with Micronutrient Formulation for Foliar Application in Rice

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## Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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## ABSTRACT

Tank mixing of agrochemicals is a common practice among farmers in order to save time and labour cost involved in crop protection. An experiment was conducted from July to November 2022 at Kerala Agricultural University to study the compatibility of tank mixing micronutrient formulation (Sampoorna KAU multimix) with post emergence herbicides for rice. The design was Randomized Block Design with thirteen treatments replicated thrice. The treatments were bispyribac sodium 0.03 kg/ ha + Sampoorna (T<sub>1</sub>), cyhalofop butyl+ penoxsulam (premix) 0.15 kg/ ha + Sampoorna (T<sub>2</sub>), 2,4-D Na salt 0.8 kg/ ha + Sampoorna (T<sub>3</sub>), metsulfuron methyl + chlorimuron ethyl (premix) 0.004 kg/ ha + Sampoorna (T<sub>4</sub>), cyhalofop butyl 0.08 kg/ ha + Sampoorna (T<sub>5</sub>), bispyribac sodium 0.03 kg/ ha (T<sub>6</sub>), cyhalofop butyl+ penoxsulam (premix) 0.15 kg/ ha (T<sub>7</sub>), 2,4-D Na salt 0.8 kg/ ha (T<sub>8</sub>), metsulfuron methyl+ chlorimuron ethyl (premix) 0.004 kg/ ha (T<sub>9</sub>), cyhalofop butyl 0.08kg/ ha (T<sub>10</sub>), hand weeding at 20 & 40 DAT (days after transplanting)+ Sampoorna (T<sub>11</sub>), hand weeding at 20 & 40 DAT (without Sampoorna) (T<sub>12</sub>) and unweeded check (T<sub>13</sub>). Sole application of herbicides and

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respective tank mix application with micronutrient formulation were carried out at 20 days after transplanting. Tank mix application of 2,4-D with Sampoorna resulted in severe crop phytotoxicity and registered significantly lower chlorophyll content at panicle initiation stage. The lower plant height, tiller number, productive tillers and yield were registered in tank mix application of 2,4-D or metsulfuron methyl+ chlorimuron ethyl (premix) with micronutrient formulation. Tank mixing of bispyribac sodium, cyhalofop butyl and cyhalofop butyl+ penoxsulam (premix) were found to be compatible with micronutrient formulation, and registered comparable weed control efficiency and grain yield to that of their sole application.

**Keywords:** Sampoorna; tank mixing; antagonism; phytotoxicity; weed control efficiency.

## 1. INTRODUCTION

Herbicide application is commonly practised in rice as an economic and viable method of weed management. Farmers practise tank mixing of agrochemicals in order to save time, labour and cost. It involves mixing of agrochemicals in spray tank shortly before application. However, most of the time mixing is carried out without scientific knowledge on compatibility of chemicals mixed. Random mixing of agrochemicals can result to compatibility or incompatibility leading to synergism or antagonism respectively. The negative interaction (antagonism) can be resulted from physical and chemical incompatibilities. Tank mixing nutrient solutions with herbicides can result in synergistic effects, thus improving weed control efficiency of herbicide (John & Sadanandan, 1989). Order in which chemicals are mixed in spray tank is also important to avoid precipitation of products (Manuchehri, 2018). Hence scientific information on compatibility of different agrochemical combinations is required for standardising tank mix combinations.

Sampoorna KAU multimix is a multinutrient formulation developed by Kerala Agricultural University containing secondary nutrients like Mg and S and micronutrients like Fe, Mn, Cu, Mo, Zn, and B (Thomas et al., 2022). It is recommended as foliar spray at 30 and 50 days after transplanting in rice. In rice, post emergence herbicides are applied by 20-25 days after transplanting. Hence, there is a scope for combining first spray of Sampoorna with post emergence herbicides in rice (Saudy et al., 2021; El-Metwally & Saudy, 2021). Therefore, the study was carried out with an objective of evaluation of weed control efficiency and compatibility of tank mix application of Sampoorna KAU multimix (rice) with common post emergence herbicides recommended for rice.

## 2. MATERIALS AND METHODS

A field experiment was conducted during July to November 2022 at Agricultural Research Station, Mannuthy, Thrissur. The soil of the experimental field is sandy clay loam, with a pH of 6.4. There were thirteen treatments, replicated thrice and the individual plot size was 5m x 4m. The treatments were bispyribac sodium @ 0.03 kg/ ha + Sampoorna (T1), cyhalofop butyl+ penoxsulam (premix) @ 0.15 kg/ ha + Sampoorna (T2), 2,4-D Na salt @ 0.8 kg/ ha + Sampoorna (T3), metsulfuron methyl + chlorimuron ethyl (premix) @ 0.004 kg/ ha + Sampoorna (T4), cyhalofop butyl @ 0.08 kg/ ha + Sampoorna (T5), bispyribac sodium @ 0.03 kg/ ha (T6), cyhalofop butyl+ penoxsulam (premix) @ 0.15 kg/ ha (T7), 2,4-D Na salt @ 0.8 kg/ ha (T8), metsulfuron methyl+ chlorimuron ethyl (premix) @ 0.004 kg/ ha (T9), cyhalofop butyl @ 0.08kg/ ha (T10), hand weeding at 20 & 40 DAT + Sampoorna (T11) , hand weeding at 20& 40 DAT (without Sampoorna) (T12) and un weeded check (T13). The rice crop (medium duration variety Uma) was transplanted 20 days after sowing in nursery. Tank mix application of herbicides and respective sole applications were carried out at 20 days after transplanting. Follow up spray of Sampoorna was done at 50 days after transplanting as per recommendation. Hand weeding was done to control other weeds in the case of narrow spectrum herbicide treatments (T3, T4, T5, T8, T9 & T10) to control other weeds, hand weeding was done.

Visual symptoms of phytotoxicity on crop was recorded at three and seven days after treatment application and injury symptoms were scored from 0 to 5 according to severity (Thomas & Abraham, 2007). Observations on plant height and tiller count was recorded at 30 days after transplanting (DAT), 60 DAT and at harvest. The weeds were uprooted, dried in hot air oven and dry weight was recorded. Chlorophyll content

was recorded. Number of panicles per hill, grain and straw yield were recorded at harvest. Weed control efficiency and percentage yield reduction were worked out.

The data generated were subjected to Analysis of Variance (ANOVA) using the statistical package KAU GRAPES (General Rshiny-based Analysis Platform Empowered by Statistics) developed by Kerala Agricultural University (Gopinath et al., 2020).

### 3. RESULTS AND DISCUSSION

Severe phytotoxicity symptom of yellowing and small brown spots on leaves were noticed in crop sprayed with tank mixed combination of Sampoorna with 2,4-D sodium salt by third day itself. However, the phytotoxicity score reduced by 7 days as new leaves were free of toxicity symptoms. No phytotoxicity was noticed in tank mix application of cyhalofop butyl, cyhalofop butyl+ penoxsulam, or bispyribac sodium with Sampoorna. Tank mixing of different compounds can lead to various interactions which may result in synergistic, antagonistic or neutral effects (Whitford et al., 2018). Crop phytotoxicity in tank mixed application of 2,4-D+ Sampoorna can be attributed to chemical or physical incompatibilities between compounds resulting in undesirable effects on crop such as crop phytotoxicity or stunted growth. Tank mixing of chemicals can lead to enhanced efficacy and cost effectiveness in herbicide application (Navya et al., 2024).

The data on plant height at 30 and 60 days after transplanting and at harvest are furnished in Table 1. At 30 DAT (days after transplanting), significant reduction in plant height was registered in tank mix application of Sampoorna with 2,4-D with a plant height of 46.57 cm while an average height of 56.33 cm was registered in sole application. 2,4-D and metsulfuron methyl+ chlorimuron ethyl registered decreased trend of plant height in comparison with other treatments. All other treatments registered higher and statistically comparable plant height. Reduction in plant height in 2,4-D+ Sampoorna was 17 % and 10 % at 30 and 60 days after transplanting respectively, compared to sole application of 2,4-D. While, metsulfuron methyl+ chlorimuron ethyl when tank mixed with Sampoorna resulted in height reduction to the tune of 13% and 6% at 30 DAT and 60 DAT, respectively. Studies show that in comparison to liquid formulations, powder formulations when tank mixed can lead to

physical incompatibilities. Hence, powder formulations of herbicides 2, 4-D (SP) and metsulfuron methyl+ chlorimuron ethyl (WP) might have resulted in physical incompatibility with Sampoorna. All other herbicides utilized in the study were liquid formulations. The crop in unweeded check registered comparable height to hand weeded plots at 30 DAT. Crop weed competition for light and space might have contributed to more plant height in unweeded check though crop health was poor (Atheena et al., 2017). At 60 DAT most of the treatments involving herbicides had comparable plant height to hand weeded plot as a result of good weed control.

Grain yield data is presented in Table 4. All the herbicides except 2,4-D and metsulfuron methyl+ chlorimuron ethyl registered grain yield statistically comparable to respective sole application and with that of hand weeded plots. Tank mixed combinations of 2,4-D or metsulfuron methyl+ chlorimuron ethyl with Sampoorna registered significantly lower grain yield (4499 kg/ha and 4917 kg/ha respectively) compared to that registered in their sole applications (5318 kg/ha and 5370 kg/ha respectively). Yield reduction registered in tank mix application of 2,4-D+ Sampoorna was 15 percent lower than 2,4-D alone and corresponding reduction in metsulfuron methyl+ chlorimuron ethyl + Sampoorna was 8 percent. Bispyribac sodium, cyhalofop butyl and premix cyhalofop+ penoxsulam, registered statistically comparable grain and straw yields in sole application and as well as tank mix application with Sampoorna. Grain yield in these treatments ranged from 5444 to 5647 kg/ha. The lowest grain yield was recorded in unweeded check (1437 kg/ha).

A straw yield of 6066 kg/ha was registered in 2,4-D while its tank mixed application with Sampoorna registered significantly lower straw yield of 5101 kg/ha (Table 4). All other herbicides tried in the study and their respective tank mixed combinations registered straw yield statistically on par with each other. This indicates that tank mixing of Sampoorna with herbicides bispyribac sodium, cyhalofop butyl+ penoxsulam and cyhalofop butyl is advisable. Comparable grain and straw yields in these treatments can be indicative of absence of any synergistic or antagonistic effect. Perusal of data on grain yield indicate absence of any synergistic effect on tank mixing of herbicides with Sampoorna.

**Table 1. Effect of herbicides tank mixed with Sampoorna on plant height of rice**

Treatments	Plant height (cm)		
	30 DAT	60 DAT	Harvest
T <sub>1</sub> Bispyribac sodium @ 0.03 kg/ ha + Sampoorna	59.17 <sup>a</sup>	91.17 <sup>a</sup>	120.33 <sup>ab</sup>
T <sub>2</sub> Cyhalofop butyl+ Penoxsulam (premix) @ 0.15 kg/ ha + Sampoorna	57.70 <sup>bc</sup>	90.93 <sup>a</sup>	119.33 <sup>ab</sup>
T <sub>3</sub> 2,4-D Na salt @ 0.8 kg/ ha + Sampoorna	46.57 <sup>g</sup>	74.67 <sup>d</sup>	99.33 <sup>e</sup>
T <sub>4</sub> Metsulfuron methyl + Chlorimuron ethyl (premix) @ 0.004 kg/ ha + Sampoorna	47.93 <sup>f</sup>	79.00 <sup>c</sup>	112.00 <sup>d</sup>
T <sub>5</sub> Cyhalofop butyl @ 0.08 kg/ ha + Sampoorna	57.03 <sup>cd</sup>	90.17 <sup>a</sup>	122.67 <sup>a</sup>
T <sub>6</sub> Bispyribac sodium @ 0.03 kg/ ha	56.50 <sup>de</sup>	90.50 <sup>a</sup>	114.67 <sup>cd</sup>
T <sub>7</sub> Cyhalofop butyl+ Penoxsulam (premix) @ 0.15 kg/ ha	57.50 <sup>bc</sup>	89.50 <sup>a</sup>	119.67 <sup>ab</sup>
T <sub>8</sub> 2,4-D Na salt @ 0.8 kg/ ha	56.33 <sup>de</sup>	83.33 <sup>b</sup>	113.00 <sup>cd</sup>
T <sub>9</sub> Metsulfuron methyl+ Chlorimuron ethyl (premix) @ 0.004 kg/ ha	55.67 <sup>e</sup>	84.67 <sup>b</sup>	114.00 <sup>cd</sup>
T <sub>10</sub> Cyhalofop butyl @ 0.08 kg/ ha	57.93 <sup>bc</sup>	89.83 <sup>a</sup>	116.67 <sup>bc</sup>
T <sub>11</sub> Hand weeding at 20 & 40 DAT + Sampoorna	57.43 <sup>bc</sup>	90.77 <sup>a</sup>	120.00 <sup>ab</sup>
T <sub>12</sub> Hand weeding at 20& 40 DAT (without Sampoorna)	57.50 <sup>bc</sup>	90.67 <sup>a</sup>	114.00 <sup>cd</sup>
T <sub>13</sub> Un weeded check (no Sampoorna)	58.03 <sup>b</sup>	89.76 <sup>a</sup>	101.00 <sup>e</sup>

*In a column, means followed by common letter do not differ significantly at 5% level in DMRT*

*\*DAT- days after transplanting*

**Table 2. Effect of herbicides tank mixed with Sampoorna on tillering of rice**

Treatments	No. of tillers/hill		
	30 DAT	60 DAT	Harvest
T <sub>1</sub> Bispyribac sodium @ 0.03 kg/ ha + Sampoorna	10.67	16.67 <sup>cde</sup>	24.33 <sup>ab</sup>
T <sub>2</sub> Cyhalofop butyl+ Penoxsulam (premix) @ 0.15 kg/ ha + Sampoorna	11.00	22.33 <sup>a</sup>	25.67 <sup>a</sup>
T <sub>3</sub> 2,4-D Na salt @ 0.8 kg/ ha + Sampoorna	9.67	9.33 <sup>f</sup>	15.33 <sup>e</sup>
T <sub>4</sub> Metsulfuron methyl + Chlorimuron ethyl (premix) @ 0.004 kg/ ha + Sampoorna	9.33	14.33 <sup>e</sup>	17.33 <sup>de</sup>
T <sub>5</sub> Cyhalofop butyl @ 0.08 kg/ ha + Sampoorna	11.00	17.67 <sup>bcd</sup>	25.00 <sup>ab</sup>
T <sub>6</sub> Bispyribac sodium @ 0.03 kg/ ha	11.33	16.67 <sup>cde</sup>	22.00 <sup>bc</sup>
T <sub>7</sub> Cyhalofop butyl+ Penoxsulam (premix) @ 0.15 kg/ ha	10.67	18.67 <sup>bc</sup>	24.00 <sup>ab</sup>
T <sub>8</sub> 2,4-D Na salt @ 0.8 kg/ ha	10.00	15.67 <sup>de</sup>	18.66 <sup>d</sup>
T <sub>9</sub> Metsulfuron methyl+ Chlorimuron ethyl (premix) @ 0.004 kg/ ha	10.33	17.00 <sup>bcd</sup>	20.00 <sup>cd</sup>
T <sub>10</sub> Cyhalofop butyl @ 0.08 kg/ ha	11.00	16.67 <sup>cde</sup>	22.00 <sup>bc</sup>
T <sub>11</sub> Hand weeding at 20 & 40 DAT + Sampoorna	10.33	19.33 <sup>b</sup>	22.33 <sup>bc</sup>
T <sub>12</sub> Hand weeding at 20& 40 DAT (without Sampoorna)	11.00	19.00 <sup>bc</sup>	23.00 <sup>abc</sup>
T <sub>13</sub> Un weeded check (no Sampoorna)	10.33	10.67 <sup>f</sup>	11.00 <sup>f</sup>

*In a column, means followed by common letter do not differ significantly at 5% level in DMRT*

**Table 3. Effect of herbicides tank mixed with Sampoorna on weed dry matter production (kg/ ha)**

Treatments	DMP 30 DAT	DMP 60 DAT	DMP at harvest
T <sub>1</sub> Bispyribac sodium @ 0.03 kg/ ha + Sampoorna	78 <sup>b</sup>	157 <sup>bc</sup>	166 <sup>b</sup>
T <sub>2</sub> Cyhalofop butyl+ Penoxsulam (premix) @ 0.15 kg/ ha + Sampoorna	79 <sup>b</sup>	160 <sup>bc</sup>	203 <sup>b</sup>
T <sub>3</sub> 2,4-D Na salt @ 0.8 kg/ ha + Sampoorna	78 <sup>b</sup>	152 <sup>bc</sup>	170 <sup>b</sup>
T <sub>4</sub> Metsulfuron methyl + Chlorimuron ethyl (premix) @ 0.004 kg/ ha + Sampoorna	78 <sup>b</sup>	154 <sup>bc</sup>	173 <sup>b</sup>
T <sub>5</sub> Cyhalofop butyl @ 0.08 kg/ ha + Sampoorna	75 <sup>bc</sup>	155 <sup>bc</sup>	173 <sup>b</sup>
T <sub>6</sub> Bispyribac sodium @ 0.03 kg/ ha	79 <sup>b</sup>	135 <sup>bc</sup>	150 <sup>b</sup>
T <sub>7</sub> Cyhalofop butyl+ Penoxsulam (premix) @ 0.15 kg/ ha	70 <sup>bcd</sup>	167 <sup>b</sup>	187 <sup>b</sup>
T <sub>8</sub> 2,4-D Na salt @ 0.8 kg/ ha	87 <sup>b</sup>	144 <sup>bc</sup>	160 <sup>b</sup>
T <sub>9</sub> Metsulfuron methyl+ Chlorimuron ethyl (premix) @ 0.004 kg/ ha	91 <sup>b</sup>	140 <sup>bc</sup>	180 <sup>b</sup>
T <sub>10</sub> Cyhalofop butyl @ 0.08 kg/ ha	91 <sup>b</sup>	133 <sup>bc</sup>	177 <sup>b</sup>
T <sub>11</sub> Hand weeding at 20 & 40 DAT + Sampoorna	43 <sup>cd</sup>	47 <sup>c</sup>	163 <sup>b</sup>
T <sub>12</sub> Hand weeding at 20& 40 DAT (without Sampoorna)	41 <sup>d</sup>	47 <sup>c</sup>	163 <sup>b</sup>
T <sub>13</sub> Un weeded check (no Sampoorna)	551 <sup>a</sup>	1240 <sup>a</sup>	1373 <sup>a</sup>

*In a column, means followed by common letter do not differ significantly at 5% level in DMRT*

**Table 4. Effect of herbicides tank mixed with Sampoorna on productive tillers per hill, grain and straw yield of rice**

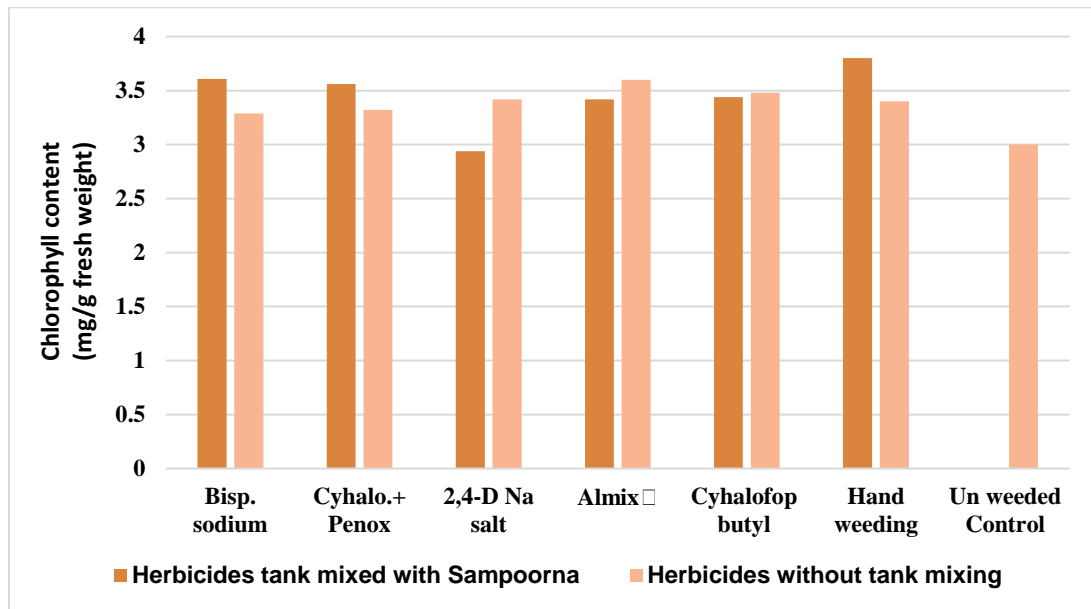
Treatments	Productive Tillers (No./ hill)	Grain yield (kg/ ha)	Straw yield (kg/ ha)
T <sub>1</sub> Bispyribac sodium @ 0.03 kg/ ha + Sampoorna	18.67 <sup>ab</sup>	5444 <sup>ab</sup>	6335 <sup>abc</sup>
T <sub>2</sub> Cyhalofop butyl+ Penoxsulam (premix) @ 0.15 kg/ ha + Sampoorna	20.00 <sup>a</sup>	5647 <sup>ab</sup>	6724 <sup>a</sup>
T <sub>3</sub> 2,4-D Na salt @ 0.8 kg/ ha + Sampoorna	13.00 <sup>d</sup>	4499 <sup>d</sup>	5101 <sup>d</sup>
T <sub>4</sub> Metsulfuron methyl + Chlorimuron ethyl (premix) @ 0.004 kg/ ha + Sampoorna	15.33 <sup>cd</sup>	4917 <sup>c</sup>	5850 <sup>c</sup>
T <sub>5</sub> Cyhalofop butyl @ 0.08 kg/ ha + Sampoorna	20.33 <sup>a</sup>	5452 <sup>ab</sup>	6311 <sup>abc</sup>
T <sub>6</sub> Bispyribac sodium @ 0.03 kg/ ha	17.67 <sup>abc</sup>	5501 <sup>ab</sup>	6657 <sup>ab</sup>
T <sub>7</sub> Cyhalofop butyl+ Penoxsulam (premix) @ 0.15 kg/ ha	18.67 <sup>ab</sup>	5607 <sup>ab</sup>	6168 <sup>abc</sup>
T <sub>8</sub> 2,4-D Na salt @ 0.8 kg/ ha	16.67 <sup>bc</sup>	5318 <sup>b</sup>	6066 <sup>bc</sup>
T <sub>9</sub> Metsulfuron methyl+ Chlorimuron ethyl (premix) @ 0.004 kg/ ha	19.66 <sup>a</sup>	5370 <sup>ab</sup>	6252 <sup>abc</sup>
T <sub>10</sub> Cyhalofop butyl @ 0.08 kg/ ha	19.33 <sup>a</sup>	5660 <sup>ab</sup>	6398 <sup>abc</sup>
T <sub>11</sub> Hand weeding at 20 & 40 DAT + Sampoorna	19.66 <sup>a</sup>	5722 <sup>a</sup>	6437 <sup>abc</sup>
T <sub>12</sub> Hand weeding at 20& 40 DAT (without Sampoorna)	20.00 <sup>a</sup>	5686 <sup>ab</sup>	6520 <sup>ab</sup>
T <sub>13</sub> Un weeded check (no Sampoorna)	10.00 <sup>e</sup>	1437 <sup>e</sup>	1753 <sup>e</sup>

*In a column, means followed by common letter do not differ significantly at 5% level in DMRT*

**Table 5. Effect of tank mix application of herbicides with Sampoorna on weed control efficiency**

Treatments	WCE (%)		
	30 DAT	60DAT	At harvest
T <sub>1</sub> Bispyribac sodium @ 0.03 kg/ ha + Sampoorna	85.72 <sup>bcd</sup>	87.32 <sup>b</sup>	87.45 <sup>a</sup>
T <sub>2</sub> Cyhalofop butyl+ Penoxsulam (premix) @ 0.15 kg/ ha + Sampoorna	85.54 <sup>bcd</sup>	87.30 <sup>b</sup>	85.15 <sup>a</sup>
T <sub>3</sub> 2,4-D Na salt @ 0.8 kg/ ha + Sampoorna	85.68 <sup>bcd</sup>	87.62 <sup>b</sup>	87.44 <sup>a</sup>
T <sub>4</sub> Metsulfuron methyl + Chlorimuron ethyl (premix) @ 0.004 kg/ ha + Sampoorna	85.67 <sup>bcd</sup>	87.47 <sup>b</sup>	86.89 <sup>a</sup>
T <sub>5</sub> Cyhalofop butyl @ 0.08 kg/ ha + Sampoorna	86.23 <sup>bc</sup>	87.50 <sup>b</sup>	87.17 <sup>a</sup>
T <sub>6</sub> Bispyribac sodium @ 0.03 kg/ ha	85.60 <sup>bcd</sup>	88.87 <sup>b</sup>	88.80 <sup>a</sup>
T <sub>7</sub> Cyhalofop butyl+ Penoxsulam (premix) @ 0.15 kg/ ha	87.11 <sup>b</sup>	86.58 <sup>b</sup>	86.23 <sup>a</sup>
T <sub>8</sub> 2,4-D Na salt @ 0.8 kg/ ha	84.10 <sup>cd</sup>	88.27 <sup>b</sup>	88.45 <sup>a</sup>
T <sub>9</sub> Metsulfuron methyl+ Chlorimuron ethyl (premix) @ 0.004 kg/ ha	83.40 <sup>d</sup>	89.12 <sup>b</sup>	86.61 <sup>a</sup>
T <sub>10</sub> Cyhalofop butyl @ 0.08 kg/ ha	83.29 <sup>d</sup>	88.96 <sup>b</sup>	86.89 <sup>a</sup>
T <sub>11</sub> Hand weeding at 20 & 40 DAT + Sampoorna	92.04 <sup>a</sup>	96.11 <sup>a</sup>	87.97 <sup>a</sup>
T <sub>12</sub> Hand weeding at 20& 40 DAT (without Sampoorna)	92.53 <sup>a</sup>	96.23 <sup>a</sup>	87.79 <sup>a</sup>
T <sub>13</sub> Un weeded check (no Sampoorna)	-	-	-

*In a column, means followed by common letter do not differ significantly at 5% level in DMRT*



**Fig. 1. Effect of tank mixing herbicides with Sampoorna on chlorophyll content (mg/g fresh weight) at panicle initiation stage of rice**

Tank mix application of herbicides with Sampoorna and respective tank mix applications registered statistically comparable weed dry matter production at all stages of observation. The data is furnished in Table 4. Unweeded control registered the highest weed dry matter accumulation of 551 kg/ ha; and other treatments registered lower and comparable values at 30DAT. By 60 DAT, weed dry matter accumulation in unweeded plot doubled to 1240 kg/ ha. All the treatments involving herbicides as well as hand weeding plots were statistically at par. Sole application as well as tank mixed applications of respective herbicides were equally efficient in terms of weed management as they registered comparable weed dry weight. Similar trend continued at harvest also. This was due to the fact that herbicide efficacy was not affected by tank mixing of 2,4-D or metsulfuron methyl+ chlorimuron ethyl with Sampoorna though it induced phytotoxicity to crop. Weed control efficiency at 30 and 60 days after transplanting and at harvest differed among different treatments and data is furnished in Table 5. Hand weeding plots were statistically on par with all other treatments in terms of WCE and were superior.

Tank mix combinations of herbicides with Sampoorna registered comparable or higher weed control efficiencies in comparison with their sole application. At 60 days after transplanting, all the treatments involving herbicides registered statistically comparable weed control efficiency.

Hand weeded plots registered significantly higher weed control efficiency at 60 DAT in comparison with other treatments.

Total chlorophyll content at panicle initiation stage differed among treatments (Fig. 1). Hand weeding registered chlorophyll content of 3.40 mg/g while hand weeding along with Sampoorna registered significantly higher chlorophyll content of 3.80 mg/g. A similar trend was noticed with bispyribac sodium on tank mixing with Sampoorna multinutrient mix. All other herbicides except 2,4-D registered comparable chlorophyll content with that of tank mixed combination with Sampoorna. Total chlorophyll content of 3.42 mg/g fresh weight was registered in sole application of 2,4-D while it reduced significantly to 2.94 mg/g fresh weight while tank mixed with Sampoorna. This can be attributed to severe phytotoxicity in application plots of 2,4-D+ Sampoorna.

#### 4. CONCLUSION

Post emergence herbicides bispyribac sodium, cyhalofop butyl+ penoxsulam (premix), and cyhalofop butyl were found to be compatible with Sampoorna KAU multimix recommended for foliar nutrition in rice. The above herbicides registered high grain and straw yields and comparable growth and yield attributes to their tank mix application with Sampoorna. Hence it is advisable to tank mix the above-mentioned herbicides with Sampoorna KAU multimix. Tank mix application of 2,4-D with Sampoorna

registered severe crop phytotoxicity, however crop was revived from symptoms at later stages of growth. Tank mix application of 2,4-D or metsulfuron methyl + chlorimuron ethyl with Sampoorna led to significant reduction in growth and yield attributes which eventually led to decreased yield in these combinations and hence are undesirable for tank mix application. Herbicide efficacy was not adversely affected on tank mixing with Sampoorna.

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Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

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### COMPETING INTERESTS

Authors have declared that no competing interests exist.

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