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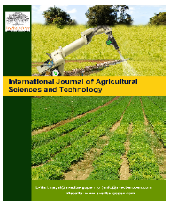

Research Paper

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Planting Methods Effect on Weed Dynamics and Weed—Crop Interaction in Finger Millet

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Abstract

A field experiment was conducted at farmer field of Sundarbazar, Lamjung during rainy season of 2020 with an objective to determine the dynamics of weed with respect different planting methods and varieties. The experiment was laid out in split plot design with three replications where five varieties (KabreKodo 1, KabreKodo 2, Dalle 1, Okhale 1 and local) were used as the main plot factor and three planting methods (Direct sowing;10x10 cm, Conventional transplanting; 10x10 cm with 15 days old seedlings and System of Crop Intensification; 25x25 cm with 30 days old seedlings) as sub plot factor. Result showed that among 5 genotypes of weeds based on Importance value index, *Cyperus rotundus* was the most dominant during the initial stage but after the first weeding, *Ageratum haustinianum* dominated the field. Weed biomass and density was recorded highest in directly sown field than that in transplanted field. Among the transplanted crop, weed infestation was seen higher in SCI than in conventionally transplanted finger millet due to wider spacing. But after the first hand weeding, due to profuse root growth and tillering in SCI, weeds were suppressed and thus weed biomass was observed higher in CT. After one hand weeding, SCI showed higher weed control index, crop resistance index and planting method efficiency index in terms of yield. Weed infestation was observed higher in Dalle 1 among varieties.

Keywords: *Planting method, Seedlings, Value index, Weed, Tillering, Efficiency*

1. Introduction

Finger millet (*Eleusinecoracana* L. Gaertn) belonging to the family Poaceae is one of the important staple cereal food crops for majority of people dependent on subsistence farming in the arid and semi-arid tropics of South Asia and Africa (Ahmed *et al.*, 2000). It can be grown in poor water retaining soil and nutrient deficient soils due to its resilience and ability to withstand aberrant weather conditions (NRC, 1996). in terms of area and production, finger millet is the most important millet crop in Nepal, followed by proso millet and foxtail millet (Ghimire *et al.*, 2019). Finger millet is fourth most important crop in Nepal in terms of area and production after rice, maize and wheat (MoAD, 2020) grown in area of 263,261 ha with average productivity of 1.19 t/ha (MoAD, 2019). Recent official data of the Ministry of Agriculture and

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Livestock Development (MoAD, 2018/19) showed that finger millet is grown in 70 districts except 2 districts of high mountains (Manang and Mustang) and 4 districts of Terai namely, Kapilbastu, Banke, Bardiaya and Kanchanpur which signifies high diversity of finger millet present in the Nepal. GEF UNEP Local Crop Project launched in the country has named it as one of the Himalayan Superfoods (Himalayan Crops, 2019). Nepal's food import data over the last five years has revealed that the value of imports has climbed from NPRs. 44.43 billion in 2009-10 to NPRs 127.51 billion in 2013-14 (Gairhe *et al.*, 2018). Even though there is increased productivity of millet over a period, Nepal has spent NRs 180.10 million to import millet in 2019 (TEPC, 2019).

Finger millet, although being a minor crop in the country, has the ability to improve the nutrition and health security of the rising urban and worldwide population in the context of rising climates and other natural conditions (Ghimire *et al.*, 2020; Gauchan *et al.*, 2020). Millets grown under de facto organic circumstances in Nepal include globally important unique gene pools of nutrition, cold, drought, and insect pest tolerance that are vital for food and nutrition security of smallholder farmers and marginalized mountain populations in the face of climate change (UNEP GEF, 2013; Ghimire *et al.*, 2018; Gauchan *et al.*, 2019). It meets multiple livelihood securities (food, fodder, nutrition, livelihood, and ecological) of smallholder mountain farmers. The crop is also nutritionally important as is gluten-free, nutrient-dense containing rich micronutrients, dietary fibers, rare amino acids, vitamins, and account for higher protein, calcium, and iron as compared to key food staples such as rice, wheat, and potato (DFTQC, 2012; Gauchan, 2019).

One of the major constrains of cereal crop production is weeds which have more potential of reducing yield (37%) as compared to other loss potentials, i.e., animal pest 18%, fungal and bacterial pathogen 16% and virus 2% (Dahal and Karki, 2014) and in case of finger millet, it is because of the popular sowing method, i.e., broadcasting in the context of Nepal (Shinggu *et al.*, 2009). The reduction in crop yield reaches up to 82% if weeds are left unchecked (Fufa and Mariam, 2016). Effective weed management practices are essential for finger millet production to prevent the depletion of plant nutrients which results in reduction of yield (Palanisamy *et al.*, 2020). initial stage of finger millet is subjected to weed infestation causing higher competition, thus resulting reduced yield (Sidar and Thakur, 2017).

2. Materials and Methods

The research was conducted on the farmers field of Sundarbazar, Lamjung during July to December, 2020 under rain fed condition which lies in the Gandaki province, Nepal with the altitude of 700 m above mean sea level, longitude 84.42°E and latitude 28.13°N.

The experiment was laid out in split plot design with three replications having five varieties of finger millet namely Kabrekodo-1, Kabrekodo-2, Dalle-1, Okhale-1 and local as main plot factor and crop establishment methods viz.Direct Sowing (DS) (10 cm X10 cm), (25 cm X25 cm with 15 days old seedlings) and conventional transplanting (10 cm X 10 cm with 30 days old seedlings) as sub plot factor. So, 45 experimental plots were designated where each plot measured 6 m^2 (3m X 2m).

3. Results and Discussion

3.1. Weed Dynamics

The finger millet field was found to be dominated by monocot weeds rather than dicot weeds. This may be due to the fact that finger millet and grass weeds both belonged to same taxonomic family and has similar morphological features. The major weeds from the experimental plots were *Echinochloacolona, Cyperusrotundus and Eleusineindica*among grasses, *Cyperusrotundus and Fimbristylismiliaceae among sedges* and Aegeratumhaustonianum, Hedyotisdiffusa, Spilanthesmauritiana, Linderniacrustacea *and Synedrellanodiflora*among broad leaf weeds.

In the experimental field, monocot weed was found to be dominant than dicot weeds. *Echinochloacolona*, *Cyperusrotundus and Eleusineindica*among grasses, Cyperusrotundus and Fimbristylismiliaceae among sedges and Aegeratumhaustonianum, *Hedyotisdiffusa*, *Spilanthesmauritiana, Linderniacrustacea and Synedrellanodiflora* among broad leaf weeds were found.It might be due to the fact that finger millet and grass weeds both belonged to same taxonomic family and has similar morphological features. Singh and Saha (2001) reported that weed flora of the experimental field were *Echinochloacrusgalli* among grasses, *Fimbristylismiliacea* among sedges, *Commelinabenghalensis* and *Aegeratumconyzoides* among broad leaved weeds on sandy clay loam soils of Ranchi, Jharkhand. in contrast, Ramamoorthy *et al.* (2002) stated that the main weeds in the experimental field in Coimbatore, Tamil Nadu, were annual broad leafed weeds such *Trianthemaportulacastrum*and *Boerhaaviadiffusa*, as well as grassy weed *Dactylocteniumaegyptium*..in the transplanted finger millet environment of Trichirappalli, Tamil Nadu, the main grass weeds were *Brachiariamutica* (L.), *Cynodondactylon* (L.), *Dactylocteniumaegyptium* (L.), *Echinochloacolona* (L.), common sedges were *Cyperusiria* (L.) and *Cyperusrotundus* (L.), and broad leaved weeds including*Eclipta alba* (L.) and *Trianthemaportulacastrum* (L.) (Shanmugapriya *et al*., 2019).

3.2. Importance Value Index (IVI)

The five most dominant weed species that are found in the finger millet at 30 DAS/DAT, 60 DAS/DAT and 90DAS/DAT based on the basis of Important Value index is presented in the table below (Table 1). During the initial stage of finger millet, *Cyperusrotundus* dominated the field and had highest Important Value index, i.e., 123.37 followed by *Echinochloacolona* (IVI = 68.41) whereas after the first weeding *Cyperusrotundus*got somewhat controlled but *Aegeratumhaustonianum* (IVI = 106.21) dominated the field followed by *Cyperusrotundus* (IVI = 60.82) and *Echinochloacolona* (IVI = 54.16). Similarly, after the second weeding, *Aegeratumhaustonianum* (IVI = 109.07) was still the dominant weed followed by *Spilanthesmauritiana* (IVI = 75.12) and *Lindernia crustacean* (IVI = 61.64).

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Table 1: Five Most Dominant Weeds at Different Weeding Intervals of Finger Millet Based on Important Value Index

Weeds at 30 DAS/DAT	IVI	Weeds at 60 DAS/DAT	IVI	Weeds at 90 DAS/DAT	IVI
Cyperusrotundus	123.37	*Aegeratumhaustonianum*	106.21	*Aegeratumhaustonianum*	109.07
Echinochloacolona	68.41	*Cyperusrotundus*	60.82	*Spilanthesmauritiana*	75.12
Aegeratumhaustonianum	57.88	*Echinochloacolona*	54.16	*Linderniacrustacea*	61.64
Synedrellanodiflora	29.22	*Spilanthesmauritiana*	41.89	*Hedyotisdiffusa*	30.56
Commelinabenghalensis	6.74	*Hedyotisdiffusa*	22.61	*Echinochloacolona*	9.60

3.3 Weed Biomass

Significant differences have been accorded between varieties and planting methods of finger millet on weed biomass at all growth stages of crop (Table 2). Highest weed biomass of 36.19 g/m^2 was found in Dalle 1 followed by 27.54 g/m^2 in Okhale 1 at 30 DAS/DAT. At60 DAS/DAT, highest weed biomass of 29.10 g/m^2 was recorded in Dalle 1 and the least15.13 g/m^2 in KabreKodo 2. Similarly at 90 DAS/DAT too, Dalle 1 had the highest weed biomass of 6.16 g/m^2 followed by 4.79 g/m^2 in Okhale 1.

With regards to planting methods weed biomass was found highest in direct sowing method than SCI and CT at all growth stage of the crop. Where weed biomass in SCI was *Preprints* (www.preprints.org) | NOT PEER-REVIEWED | Posted: July 19, 2022 doi:10.20944/preprints202207.0289.v1 25.91 g/m^2, 13.99 g/m^2 and 2.67 g/m^2 at 30 DAS/DAT, 60 DAS/DAT and 90 DAS/DAT respectively. Similarly weed biomass in DS and CT also decreased from 31.30 g/m^2 and 19.40 g/m^2 at 30 DAS/DAT to 26.86 g/m^2 and 19.47 g/m^2 at 60 DAS/DAT to 6.57 g/m^2 and 3.60 g/m^2 at 90 DAS/DAT respectively. interaction of varieties and planting methods also have significant impact in weed biomass at different growth stage of finger millet.

Dalle 1 has got highest weed biomass on 30 DAT, 60 DAT as well as in 90 DAT. With regards to planting methods weed biomass was found highest in direct sowing method than SCI and CT at all growth stage of the crop. Weed infestation is higher in early growth stage of crop and goes on decreasing as the growth stage in crop advances due to slow development in initial phase of finger millet (Kujur *et al.*, 2019). Similarly SCI and CT method of planting showed less weed biomass than in DS, due to quicker stand of crop at early stage providing profuse growth of crop and decreasing food and light competition for weed growth (Chavan *et al.*, 2017). According to Anitha and Chellappan (2011), transplanting seedlings at their juvenile age (10 days) significantly suppressed weeds due to adequate leaf coverage and tiller production through early utilization of phyllo chronic potential, which resulted in 25.81 and 25.53% higher weed control over aged seedling (15 days) at 60 DAT in 2010 and 2011, respectively. in practice, the majority of studies confirm that reducing crop row spacing reduces weeds, although it does not necessarily increase yields (Mohler, 2001). The effectiveness of reduced row spacing on weed control depends on several other factors, including water limitations, nutrient placement, crop to weed height ratio, and crop versus weed emergence timing. However, several recent studies have shown increased uniformity can work cooperatively with increased planting density to significantly reduce weed biomass and raise yields in a variety of crops (Olsen *et al.*, 2012; Marín and Weiner, 2014).

Table 2: Effect of Varieties and Planting Methods on Weed Biomass at Different Weeding Intervals of Finger Millet

Treatments	Weed Biomass(g/m²)		
	30 DAS/DAT	60 DAS/DAT	90 DAS/DAT
Varieties			
Kabrekodo 2	20.97[c]	15.13[c]	3.92[bc]
Kabrekodo 1	22.76[c]	16.01[c]	3.25[c]
Local	20.23[c]	16.68[c]	3.28[c]
Dalle 1	36.19[a]	29.10[a]	6.16[a]
Okhale 1	27.54[b]	23.53[b]	4.79[b]
F-test	**	**	**
LSD	2.59	3.68	0.89
CV%	9.40%	16.70%	19.20%
Planting Method			
DS	31.30[a]	26.86[a]	6.57[a]
SCI	25.91[b]	13.99[c]	2.67[c]
CT	19.40[c]	19.47[b]	3.60[b]
F-test	**	**	**
LSD	1.4	2.05	0.89
CV%	7.40%	13.40%	27.20%
GM	25.54	20.11	4.281
Interaction	NS	S	S

Note: **= significant at 0.01 and treatments with same letter are not significantly different; DAS= Days after sowing, DAT= Days after transplanting, DS= Direct Sowing, SCI= System of Crop Intensification, LSD= Least Significant Difference, CV=Coefficient of Variation, GM= Grand Mean, NS= Non Significant, S= Significant.

3.4 Weed Density

Varieties and planting methods differ significantly in terms of weed count per m^2 at different growth stages of finger millet (Table 3). Statistically similar high weed density 453.67 per m^2 and 442.56 per m^2 was recorded in varieties Okhale 1 and Dalle 1 respectively, whereas least weed density 259.44 per m^2 was recorded in KabreKodo 1 that was statistically similar with weed density in KabreKodo 1 and Local variety at 30 DATS/DAS. Whereas high weed density of 351 per m^2 and 220 per m^2 was recorded in Dalle 1 60 DAS/DAT and 90 DAS/DAT respectively. Least weed density of 188.78 per m^2 and 141per m^2 at 60 DAS/DAT and 90 DAS/DAT respectively was recorded in Local variety.

Table 3: Effect of Varieties and Planting Methods on Weed Density at Different Weeding Intervals of Finger Millet

Treatments	Weed Count Per m^2		
	30 DAS/DAT	60 DAS/DAT	90 DAS/DAT
Varieties			
Kabrekodo 2	307.00^{b}	243.89^{bc}	165.78^{bc}
Kabrekodo 1	259.44^{b}	211.00^{bc}	153.67^{c}
Local	272.11^{b}	188.78^{c}	141.00^{c}
Dalle 1	442.56^{a}	351.00^{a}	220.33^{a}
Okhale 1	453.67^{a}	288.33^{ab}	186.56^{b}
F-test	**	**	**
LSD	2.6	79.0	30.4
CV%	9.40%	28.3	16.10%
Planting Method			
DS	468.5^{a}	322.1^{a}	208.9^{a}
SCI	332.1^{b}	247.2^{b}	142.7^{c}
CT	240.3^{c}	200.5^{c}	168.8^{b}
F-test	**	**	**
LSD	58.72	21.77	22.15
CV%	22.20%	11.10%	16.30%
GM	346.957	223.267	173.467
Interaction	NS	S	S

Note: **= significant at 0.01 and treatments with same letter are not significantly different; DAS= Days after sowing, DAT= Days after transplanting, DS= Direct Sowing, SCI = System of Crop Intensification, LSD= Least Significant Difference, CV=Coefficient of Variation, GM= Grand Mean, NS= Non Significant, S= Significant.

Planting method DS recorded weed density of 468.5 per m^2, 322.1 per m^2, 208.9 per m^2 at 30 DAT/DAS, 60 DAT/DAS and 90 DAT/DAS respectively. SCI recorded 332.1 weeds per m^2, 247.2 weeds per m^2 and 142.7 weeds per m^2 and CT recorded 240.3 weeds per m^2, 200.5 weeds per m^2 168.8 weeds per m^2 at 30 DAS/DAT, 60 DAS/DAT and 90 DAS/DAT respectively.

Significant variations also produced due to competitive cultivars in reduction of population of weeds. Dalle 1 was found to have high weed density at 30 DAT at par with Okhale 1. Dalle 1 was also recorded high weed density even at 60 DAT and 90 DAT whereas local variety was recorded to have low weed density at all 30 DAT, 60 DAT and 90 DAT. Significantly maximum weed density was recorded under Dalle 1 variety probably due to lesser foliage and shy in tillering habit. Weed density was seemed to be higher in short and dwarf varieties since they are less competitive against weeds. Weed biomass and density was recorded highest in directly sown field than that in transplanted field. Among the transplanted crop, weed infestation was seen higher in SCI than in conventionally transplanted finger millet due to wider spacing. But after the first hand weeding, due to profuse root growth and tillering in SCI, weeds were suppressed and thus weed biomass was observed higher in CT. Lower weed density in SCI is due to increasing crop growth rates and yields suppressing weed growth and competitiveness brought about by optimum plant population enhancing more canopy radiation interception (Fanadzo *et al.*, 2010). Least weed density in SCI may also be resulted from profuse tillering and root growth that suppressed the weed growth (Amare and Etagegnehu, 2016). With SRI, more weeds were seen at a wider spacing (25 × 25 cm) than with standard cultivation. in the early stages of crop growth, an aggressive flush of both terrestrial and aquatic weeds emerges as a result of alternate dry and wetting. Frequent aerobic condition of soil and high temperature favour the growth of grassy weeds in rice (Shukla *et al.*, 2015).

3.5 Weed Control Index

Differential response of varieties and planting methods have been observed in WCI at different stage of finger millet (Table 4). Higher WCI of value 53.77%, 63.32% and 61.58 at 30, 60 and 90 DAS/DAT in KabreKodo 2 and 49.74%, 61.66% and 68.70% in Kabre Kodo1 at 30, 60 and 90 DAS/DAT were observed respectively. Dalle 1 with WCI 21.42%, 30.47% and 39.37% at 30, 60 and 90 DAS/DAT followed by Okhle 1 with WCI 39.19%, 44.20% and 59.15% at at 30, 60 and 90 DAS/DAT showed lower control after respective weeding. Result indicated good control of weed in SCI followed by CT and DS.

Higher WCI of value 53.77%, 63.32% and 61.58 at 30, 60 and 90 DAS/DAT in KabreKodo 2 and 49.74%, 61.66% and 68.70% in Kabre Kodo1 at 30, 60 and 90 DAS/DAT were observed respectively. Dalle 1 with WCI 21.42%, 30.47% and 39.37% at 30, 60 and 90 DAS/DAT followed by Okhle 1 with WCI 39.19%, 44.20% and 59.15% at at 30, 60 and 90 DAS/DAT showed lower control after respective weeding. Due to the abundant leaves and tilleringof cultivars with vigorous rooting tendency, cultivars also performed an essential role in weed control (Dass *et al.*, 2015). Hybrid cultivar showed their high competitive potential against weed control in contrast to other variety during the study done by Shukla *et al.* (2015). Result indicated good control of weed in SCI followed by CT and DS. Similar results have been reported by (Shinggu and Gani, 2012). This is brought about by the reduction in weed density by weeding, where the weed density can no further increase in later crop duration due to due robustness triggering extensive tillering with adventitious root system (Kujur *et al.*, 2019; Pandey *et al.*, 2018).

Table 4: Effect of Varieties and Planting Methods on Weed Control Index at Different Weeding Intervals of Finger Millet

Treatments	Weed Control Index (WCI)		
	30 DAS/DAT	60 DAS/DAT	90 DAS/DAT
Varieties			
Kabrekodo 2	53.77	63.32	61.58
Kabrekodo 1	49.74	61.66	68.70
Local	55.38	60.27	73.62
Dalle 1	21.42	30.47	39.37
Okhale 1	39.19	44.20	59.15
F-test	**	**	**
LSD	5.24	6.53	13.01
CV%	11%	11.60%	19.80%
Planting Method			
DS	30.88	36.08	42.99
SCI	42.82	66.40	73.19
CT	58.01	53.46	64.65
F-test	**	**	**
LSD	3.27	83.963	7.922
CV%	9.80%	10%	17.70%
GM	43.90	51.98	60.27
Interaction	S	S	S

Note: **= significant at 0.01 and treatments with same letter are not significantly different; DAS= Days after sowing, DAT= Days after transplanting, DS= Direct Sowing, SCI= System of Crop Intensification, LSD= Least Significant Difference, CV=Coefficient of Variation, GM= Grand Mean, NS= Non Significant, S= Significant.

Table 5: Effect of Varieties and Planting Methods on Weed Persistent Index at Different Weeding Intervals of Finger Millet

Treatments	Weed Persistence Index (WCI)		
	30 DAS/DAT	60 DAS/DAT	90 DAS/DAT
Varieties			
Kabrekodo 2	1.51^{bc}	0.74^{c}	0.72^{b}
Kabrekodo 1	1.70^{ab}	0.81^{bc}	0.72^{b}
Local	1.15^{c}	0.99^{ab}	0.68^{b}
Dalle 1	2.07^{a}	1.56^{a}	0.88^{a}
Okhale 1	1.61^{b}	0.88^{bc}	0.95^{a}
F-test	**	**	**
LSD	0.42	0.21	0.11
CV%	23.90%	21.00%	13.30%
Planting Method			
DS	1.22^{b}	1.06^{a}	1.12^{a}
SCI	1.14^{b}	0.66^{b}	0.47^{c}
CT	2.47^{a}	1.03^{a}	0.77^{b}
F-test	**	**	**
LSD	0.25	0.12	0.09
CV%	20.40%	17.10%	15.60%
GM	1.61	0.91	0.79
Interaction	S	S	S

Note: **= significant at 0.01 and treatments with same letter are not significantly different; DAS= Days after sowing, DAT= Days after transplanting, DS= Direct Sowing, SCI = System of Crop Intensification, LSD= Least Significant Difference, CV=Coefficient of Variation, GM= Grand Mean, NS= Non Significant, S= Significant.

3.6. Weed Persistent Index (WPI)

Weed Persistent index was significantly affected by planting methods and variety of finger millet (Table 5). Variety Dalle 1 had the highest WPI throughout the cropping season with value of 2.07, 1.56 and 0.88 at 30 DAS/DAT, 60 DAS/DAT and 90 DAS/DAT respectively. Lower WPI however was recorded by Local variety (1.15) 30 DAS/DAT, statistically similar KabreKodo 1 (0.81) and KabreKodo 2 (0.74) 60 DAS/DAT and, statistically non-significant KabreKodo 1 (0.72), KabreKodo 2 (0.72) and Local (0.68) at 90 DAS/DAT respectively.

At the initial stage 30 DAS/DAT, WPI of CT was highest (2.473) followed by DS (1.215) and SCI (1.135) but after the first hand weeding, i.e., 60 DAS/DAT, WPI of CT (1.03) and DS (1.06) was statistically similar and higher than SCI (0.66) and after second hand weeding, i.e., 90 DAS/DAT, DS (1.118) had highest WPI followed by CT (0.774) and SCI (0.471). The interaction of variety and planting methods showed significant effect on the weed persistent index. The results indicated that hand weeding was effective in controlling weeds in SCI planting method in comparison to DS and CT.

Variety Dalle 1 had the highest WPI throughout the cropping season with value of 2.07, 1.56 and 0.88 at 30 DAS/DAT, 60 DAS/DAT and 90 DAS/DAT respectively. At the initial stage 30 DAS/DAT, WPI of CT was highest (2.473) followed by DS (1.215) and SCI (1.135) but after the first hand weeding, i.e., 60 DAS/DAT, WPI of CT (1.03) and DS (1.06) was statistically similar and higher than SCI (0.66) and after second hand weeding, i.e., 90 DAS/DAT, DS (1.118) had highest WPI followed by CT (0.774) and SCI (0.471). Due to lesser weed infestation and increased efficacy of treatments for increasing WCE, the Weed Control index decreased significantly, resulting in higher grain yield SCI (Roy, 2012).

3.7. Crop Resistance Index (CRI)

Varieties and planting methods of finger millet had significant effect on crop resistance index (Table 6). The tall variety Kabrekodo 2 had highest CRI throughout three hand weeding, i.e., at 30 DAS/DAT, 60 DAS/DAT and 90 DAS/DAT with values of43.28, 10.57 and 7.82 respectively. Lower CRI value of 12.47, 5.54and 3.06 at 30 DAS/DAT, 60 DAS/DAT and 90 DAS/DAT respectively was recorded by Okhale 1. Among the three planting methods, SCI had highest CRI of 35.91 at 30 DAS/DAT but after the first hand weeding CT had highest CRI of 10.94 and after the second hand weeding, again SCI had highest CRI 7.69 followed by CT 5.27. Planting method DS have extremely lower and least CRI throughout the period with values of 3.43 at 30 DAS/DATT, 2.06 at 60 DAS/DAT and 1.75 at 90 DAS/DAT. The effect of interaction of variety and planting methods had non-significant effect on crop resistance index.

Table 6: Effect of Varieties and Planting Methods on Crop Resistance Index at Different Weeding Intervals of Finger Millet

Treatments	Crop Resistance Index (CRI)		
	30 DAS/DAT	60 DAS/DAT	90 DAS/DAT
Varieties			
Kabrekodo 2	43.28[a]	10.57[a]	7.82[a]
Kabrekodo 1	21.32[b]	8.47[b]	5.10[b]
Local	18.99[b]	6.37[c]	5.48[b]
Dalle 1	15.5[b]	5.64[c]	3.07[c]
Okhale 1	12.47[b]	5.54[c]	3.06[c]
F-test	**	**	**
LSD	12.79	1.63	1.72
CV%	53%	20.30%	32.20%
Planting Method			
DS	3.43[c]	2.06[c]	1.75[c]
SCI	35.91[a]	9.1[b]	7.69[a]
CT	27.59[b]	10.94[a]	5.27[b]
F-test	**	**	**
LSD	5.99	1.53	0.75
CV%	35.20%	27.30%	20.00%
GM	22.31	7.37	4.90
Interaction	NS	NS	NS

Note: **= significant at 0.01 and treatments with same letter are not significantly different; DAS= Days after sowing, DAT= Days after transplanting, DS= Direct Sowing, SCI= System of Crop Intensification, LSD= Least Significant Difference, CV=Coefficient of Variation, GM= Grand Mean, NS= Non Significant, S= Significant.

Tall variety Kabrekodo 2 had highest CRI throughout three hand weeding, i.e., at 30 DAS/DAT, 60 DAS/DAT and 90 DAS/DAT with values of43.28, 10.57 and 7.82 respectively. Among the three planting methods, SCI had highest CRI of 35.91 at 30 DAS/DAT but after the first hand weeding CT had highest CRI of 10.94 and after the second hand weeding, again SCI had highest CRI 7.69 followed by CT 5.27. Planting method DS have extremely lower and least CRI throughouthe period.

3.8. Planting Method Efficiency Index (PMEI)

Planting Method Efficiency index (PMEI) of SCI (78.67) was found to be the highest followed by CT (2.88) and DS (0) (Table 7). This indicates that the weed control potential of SCI is greater in comparison to CT and DS planting methods.

Table 7: Planting Method Efficiency Index of Different Planting Methods of Finger Millet

Planting Methods	Weed Biomass at Harvest (g/m^2)	Yield (g/m^2)	PMEI
DS	34.99	211.01	0
SCI	12.7	271.26	78.67
CT	18.5	234.3	2.88

DS having lowest PMEI indicates that this method of crop growth is susceptible to weeds and has adverse impact on yield.

Planting Method Efficiency Index (PMEI) of SCI (78.67) was found to be the highest followed by CT (2.88) and DS (0). This indicates that the weed control potential of SCI is greater in comparison to CT and DS planting methods. DS having lowest PMEI indicates that this method of crop growth is susceptible to weeds and has adverse impact on yield. Dass *et al.* (2015) also reported significantly higher grain yield (6.5 and 6.7 tons/ha) over older aged seedling (15 days old) with mean grain yield of 6.2 and 6.3 tons/ha during 2010 and 2011, respectively which might be because younger age of seedling (10 days) utilized phyllo chronic potential to produce higher yield.

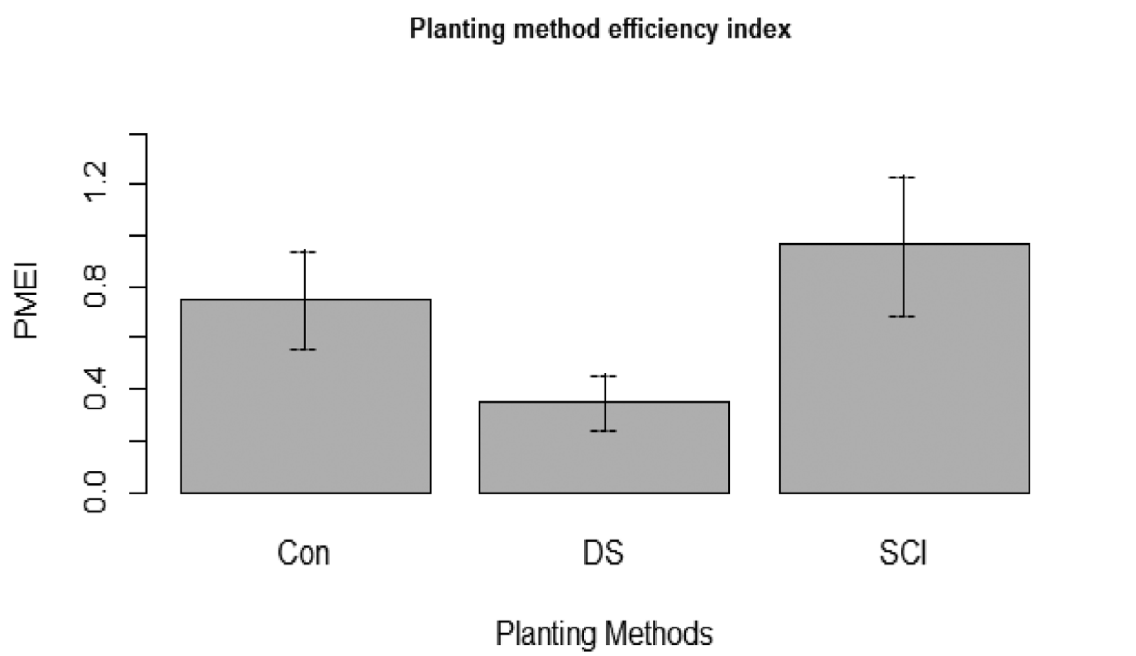

Figure 1: Effect of Different Finger Millet Planting Methods on PMEI

4. Conclusion

Cyperusrotundus was dominant during the initial stage of finger millet but after the first weeding, *Aegeratumhaustoninaum* dominated the field. Weed biomass and density were seen the highest on directly sown field on all three weeding. Weed biomass in the Dalle1 variety was found highest during 30 DAS/DAT and weed density was found highest in Dalle 1 and Okhale 1, whose densities were statistically similar. On 60 DAS/DAT and 90 DAS/DAT, DS had the highest biomass and densities whereas Dalle 1 variety had highest weed biomass and density. CT showed higher weed control index during the initial stage but SCI showed high WCI at the later stage. The variety Dalle 1 had the highest WPI throughout the cropping season and SCI had the lowest WPI. Kabrekodo2 had highest CRI throughout three hand weeding. Among the three planting methods, SCI had highest CRI at 30 DAS/DAT but after the first hand weeding CT had highest CRI and after the second hand weeding, SCI had highest CRI followed by CT and DS. Also, planting method efficiency index is found highest in SCI followed by CT and DS.

From the experiment, it can be inferred that, transplanting method is effective in finger millet for weed control and among the transplanting method, SCI method is effective in comparison to conventional transplanting for weed suppression and increase the yield.

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References

Baral, K. (2011). Variability study of Nepalese Wheat Landraces and Advanced Breeding Lines For Drought and Terminal Heat Stress. M.Sc. Thesis, T. U., Nepal. 63p.

Bhattarai, R., Ojha, B., Thapa, B., Kharel, D., Ojha, R.A. and Sapkota, M. (2017). Evaluation of Elite Spring Wheat (*Triticumaestivum L.*) Genotypes for Yield and Yield Attributing Traits under Irrigated Condition. *international Journal of Applied Sciences and Journal of Biotechnology*, 5, 194-202.

Bhatty, R. (1999). The Potential of Hullless Barley. *Cereal Chemistry*, 76, 589-599.

Bothmer, R.V. (1992). The Wild Species of Hordeum: Relationship and Potential Use For Improvement of Cultivated Barley. *in:* P. R. Shewry (ed.). Proceedings of Barley: Genetics and Biochemistry. London Seminar on Molecular Biochemistry, March 2-3, 1992. CAB, London, pp. 3-18.

Duncan, D.B. (1951). A Significance Test For Differences Between Ranked Treatment Means in An Analysis of Variance. *Virginia Journal of Science*, 2, 171-189

FAOSTAT. (2019). Statistical Crops Database of Food and Agriculture of United Nations. Website: http://www.fao.org/faostat/en/#data/QC

Ghimire, K.H., Joshi, B.K., Gurung, R., Palikhey, E., Pudasaini, N. and Parajuli, A. (2019). Adaptability of Naked Barley Landraces in Mountain Agro-ecosystem of Nepal. *Journal of Nepal Agricultural Research Council*, 5, 34-42.

Gomez, K. A. and A. A. Gomez. 1984. Statistical Procedures for Agricultural Research. John Wiley and Sons, New Delhi, 680 p.

Karkee, A., Ghimire, K.H. and Joshi, B.K. (2020). Evaluation of Naked Barley Landraces for Agro-morphological Traits. *Journal of Nepal Agricultural Research Council*, 6, 34-43.

Koutu, G. K., Shukla, R.S., Khare, D. and Singh, C.B. (1987). Response of Nitrogen Uptake and Nitrogen Harvest index in Barley (Hordeumvulgare L.). *Journal of Research and Development*, 4, 134-38.

Larinow, Yu. S. (1975). Correlation of Ear Yield in Spring Wheat. *Jouranl of Plant Breeding*, 12, 937-952.

MOAD. (2020). Statistical information on Nepalese Agriculture (2019/2020). Government of Nepal, Ministry of Agricultural Development, Agribusiness Promotion and Statistics Division, Kathmandu, Nepal. 4 p.

Mohammadi, M., Ceccarelii, S. and Naghavi, M.R. (2006). Variability and Genetic Parameters For Related Traits To Drought Tolerance in Doubled Haploid Population of Barley (*Hordeumvulgare L.*). *international Journal of Agriculture Biology*, 85: 694-697.

Murphy, P.J. and Witcombe, J.R. (1981). Variation in Himalayan Barley and The Concept of Centres of Diversity. Proceedings of The Fourth international Barley Genetics Symposium on Variation in Himalayan barley and the Concept of Centres of Diversity. *Edinburgh Journal of Botany*, 8, 26-36.

Nanda, J.S., Chaudhary, N.C. and Singh, H. (1971). Path Coefficient Analysis and Discriminant Function in Dwarsrice. *Rice Agric. Tech. Bull*, 40.

NARC. (2012). Released and Registered Crop Varieties in Nepal. Nepal Agricultural Research Council, Khumaltar, Lalitpur. 12 p.

Neupane, S.P. (2009). Variability of Physio-morphological Traits and Assessment of Helminthosporium Leaf Blight and Leaf Rust Severity in Wheat Genotypes. M.Sc. Thesis Tribhuvan University, Nepal, 73 p.

Oja, B.R. (2014). Assessment of Morpho-physiological Traits Released To Post Anthesis Drought in Wheat Genotypes Under – Rain Fed Conditions Rampur, Chitwan. *in:* N.R. Devkota (ed.). Procedding of AFU research in Nepal. Agriculture and Forestry University, Chitwan, Nepal, 1, 77-87.

Ojha, B.R. (2010). Characterization, Evaluation and Screening of Drought Tolerant Wheat Genotypes At Khumaltar,Paper Presented At The Conference Organized by Nepal Academy of Science and Technology, 27 Dec. 2010. Khumaltar, Lalitpur, Nepal.

Ojha, B.R. and Ojha, A. (2012). Selection of Drought Tolerant Promising Wheat Genotypes Suitable for Chitwan, Nepal. *Journal of Plant Breeding*, 7, 38-47.

Ouda, S.A., El-Mesiry, T. and Gaballah, M.S. (2007). Using Stabilizing Agents on increasing Yield and Water Use Efficiency in Barley Grown Under Water Stress. *Australian Journal of Basic and Applied Sciences*, 1, 571-577.

Pal, D., Kumar, S. and Verma, R.P.S. (2012). Pusa Losar (BHS 380) - The First Dual Purpose Barley Variety For Northern Hills of india. *indian Journal of Agricultural Sciences*, 82, 164-165.

Palikhey, E., Sthapit, S.R., Gauchan, D. and Sthapit, B.R. (2017). Baseline Survey Report, Haku, Jumla, Pokhara: LIBIRD, NARC, DOA and Bioversity international.

Paplauskiene, V., Leistrumaite, A. and Basiuliene, B. (2001). Evaluation of Chlorophyll Content and Yield Components in Spring Barley Doubled Haploid Lines. *Journal of Biologija*, 1, 68-70.

Poudel, A., Ojha, B.R., Ghimire, S.K. and Thapa, D.B. (2015). Genotypic Response of Spring Wheat To Terminal Heat Stress in Chitwan. *in*: N. R. Devkota (ed.). Procedding of AFU research in Nepal. Agriculture and Forestry University, Chitwan, Nepal, pp.125-133.

Rukavina, H. (1999). Seed Size, Yield, Yield Components and Malt Quality of Different Spring Barley Cultivars. Sjamenarsto, 16, 13- 56.

Shahi, D., B. R. Ojha, S. K. Ghimire and M.R. Bhatta. (2015). Evaluation of Variability and Genetic Parameters For Yield and Yield Attributing Traits in Spring Wheat (*Triticumaestivum L.*). *in*: N. R. Devkota (ed.). Procedding of AFU research in Nepal. Agriculture and Forestry University, Chitwan, Nepal. 167-173.

Sharma, R.C. (1993). Selection For Biomass Yield in Wheat. Euphytica, 70, 35-42.

Sharma, T. R. and Gandhi, S.M. (1977). Variability and inter-relationship Among Yield and Various Agronomic Characters in Common and Durum Wheat. *Zeitschrifffurpflanzenzvchtung*, 79, 40-49.

Sidwell, R.J., Smith, E.L. and McNew, R.Q. (1976). inheritance and interrelationships of Grain Yield and Selected Yield-Related Traits in a Hard Red Winter Wheat Cross. *Crop Science*, 16, 650-654.

Singh, B. and Awasthi, O.P. (1984). Correlation Studies Between Yield and Yield Attributing Characters in Dwarf Wheat. *indian Journal of Agronomy*, 29, 561-562.

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