

**A NEW COWPEA VARIETY (*Vigna unguiculata* (L.) Walp.)
SUITABLE FOR DRY AND INTERMEDIATE ZONES OF
SRI LANKA - ANKCP 02**

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ABSTRACT

Cowpea is a grain legume crop with many attributes for tolerance to harsh environmental conditions existing in the Dry zone rainfed farming systems of Sri Lanka. With the objective of developing cowpea varieties with high yield and better consumer preference, a hybridization and selection program was carried out at the Grain Legumes and Oil Crops Research and Development Center (GLORDC) from *Yala* 2011 season to *Maha* 2015/16 season. Crosses were done and six cross combinations were advanced using modified bulk method up to F₄ generation. Fourteen advanced breeding lines were selected and tested in preliminary yield trial and major yield trial during *Maha* 2013/14 and *Yala* 2014, respectively. Better performing lines were tested at National Coordinated Variety Testing (NCVT) trials during *Maha* 2014/15, to *Maha* 2015/16. Selected lines were tested for the adaptability during *Maha* 2015/16 and *Yala* 2016 in farmer fields. ANKCP 02 varieties performed well in the station yield trials. The highest yield recorded by ANKCP 02 (1,458 kg/ha) was at Maha-Illuppallama. According to the ranking method, ANKCP 02 ranked as 01 and received rank 02 with respect to variance component ranking method during *Maha* 2014/15 season. In adaptability testing at farmers' fields, it ranked as 01 during 2016 *Yala* and received rank 02 in *Maha* 2015/16. According to the farmers' responses, seed quality characters of the new variety is higher compared to the standards, cooking qualities

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and the taste also preferred by the consumers. Hence ANKCP 02 was recommended for cultivation in 2017 by Varietal Releasing Committee of the Department of Agriculture.

Keywords: Adaptability, ANKCP 02, Cowpea, High yielding

INTRODUCTION

Cowpea is one of the main grain legumes of the cropping systems in the drier region of Sri Lanka. It is an inexpensive source of protein and cultivated by the low income generating farmers under rainfed conditions in Dry and Intermediate zones. Being a fast growing crop, cowpea reduces erosion by covering the ground, fixes atmospheric nitrogen and subsequently contributes for the soil fertility (Hewavitharane, 2010).

In 2016, cowpea was cultivated in nearly 8,220 ha and the annual production was 137,406 mt (AgStat, 2017). Seven cowpea varieties, namely, Bombay, MI 35, Waruni, Dhawala, Wijaya, MICP1 and ANKCP1 were released in 1960, 1969, 1990, 1997, 1999, 2012 and 2014, respectively by the Department of Agriculture. Except MI 35, MICP 1 and ANKCP 01, all other varieties were released as introduction and selection by the Department of Agriculture. Among the conventional cowpea growing farmers, popularity of recommended varieties was at considerably low level and most of the farmers used to grow local cultivars. Farmers prefer to have dual purpose cowpea varieties to consume immature seed for curry and dry seed after boiled. Conventional cowpea growing farmers have their own cultivars, among them one collection called as “*Kadala*” a large seeded dual purpose cowpea with low yield. Therefore, this study was carried out to develop a farmer preferred cowpea variety with better adaptability for diverse environmental conditions by exploiting the variability created by the hybridization, followed by subsequent selection process.

MATERIALS AND METHODS

Six cross combinations were made using MI 35 and Dhawala with selected lines of farmer filed collections numbered CP19, CP20 and CP21. Hybridization was carried out during *Yala* 2011 season. F₁ populations were advanced during *Maha* 2011/12 and modified bulk method was used to select at F₂, F₃ and F₄ generations from *Yala* 2012 to *Yala* 2013. From the advanced breeding lines of the tested crosses fourteen lines were

selected and evaluated in preliminary Yield Trial (PYT) and Major Yield Trial (MYT) with standard check varieties in a Randomized Complete Block Design (RCBD) during *Maha* 2013/14 and *Yala* 2014 seasons. The plot size was 4×2.4 m and with 30×15 cm spacing between and within rows, respectively. Better performing lines were nominated for National Coordinated Varietal Test (NCVT) trials and evaluated during *Maha* 2014/15, *Yala* 2015 and *Maha* 2015/16 seasons. NCVT consists with three entries and three standard checks in RCBD with three replicates in 4×2.4 m plots and 30×15 cm spacing. Agronomic characters were recorded along with the plot yields. Entries were tested at Dry zone locations, namely, Aralaganwila, Agunakolapallessa, Maha-Iluppallama and Weerawila. The best performers were selected for Varietal Adaptability Test (VAT) in farmer fields with one standard check in RCBD with two replicates. Plot size was maintained as 4×4 m and 30×15 cm spacing. The VAT trials were conducted at Ampara, Hambantota, Puttalm, Anuradahapura, Ratnapura and Moneragala during *Maha* 2015/16 and *Yala* 2016. The best lines out of VAT were tested in large scale VAT in 300 m² plots and 30×15 cm spacing at Anuradapura, Moneragala, Polonnaruwa and Hambanthota during *Yala* 2016 and *Maha* 2016/17.

Agronomic characters of selected line along with recommended varieties were studied. Sensory evaluation was conducted using the selected best line, ANKCP 02 and the recommended varieties Bombay, ANKCP 1 and MICP 1. Boiled cowpea seeds were evaluated for consumer perception with participation of tasting panel of 25 staff members of GLOCRDC. Samples were evaluated for color, texture, taste and aroma by the panel of tasters.

Data analysis

Yield trials at research station were analyzed using analysis of variance and followed by mean separation with Least Significant Difference (LSD) using SAS. Multi-location yield data of NCVT were analyzed using both ranking method (Das, 1982) and variance component method (Abey Siriwardena, 1991). Yield data of the tested varieties were analyzed separately for each location and the mean yields were ranked according to DMRT for the ranking method evaluations. Mean rank and variance of ranks over locations were calculated based on the ranks of individual locations. Final adaptability was given based on mean rank and variance components. Adaptability rank 01 was given

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to the highest mean rank with insignificant variance. First deviation from the location mean of individual variety was calculated for variance component method. Deviations within locations were analyzed using analysis of variance in SAS. Mean deviation over location was calculated. Number of positive deviations over locations, mean deviation over location and interaction variance between 'location x variety' were computed in Excel. According to the above three parameters, adaptability ranks were given to each variety. Varieties with maximum number of positive mean deviations and insignificant interaction variance and higher mean yield received the better ranks. VAT data were analyzed using ranking method.

RESULTS AND DISCUSSION

Station yield trial

Yield performance of evaluated lines and the standard check varieties in PYT and MYT during *Maha* 2013/14 and *Yala* 2014 season at GLORDC, Angunakolapellassa are presented in Table 1. There was no significant difference ($p < 0.05$) among tested lines for yield during *Maha* 2013/14 evaluation in PYT. There was a significant difference ($p < 0.05$) among the tested lines during *Yala* 2014 evaluations and the highest yield recorder was ANKCP 02 during both seasons.

National Co-ordinated Varietal Trial (NCVT)

With respect to ranking method analysis, performance of tested lines were presented as mean yield of each line in individual locations and mean ranks in Tables 2 for the tested four seasons.. Based on the mean rank, rank 01 was given to ANKCP 02, Waruni received rank 2 and ANKCH2 received the rank 03 for *Maha* 2014/15 season analysis. In *Yala* 2015 ANKCH 3 received rank 01, Waruni ranked as 02 while ANKCP 02 received rank 03. During *Maha* 2015/16 adaptability rank 1 was given to ANKCP 02, ANKCH 2 received rank 2 and ANKCP 1 received the rank 3.

. According to variance component method, ANKCP 01 received rank 01 and ANKCP 02 received rank 02 during *Maha* 2014/15 season (Table 3). ANKCP 02 received rank 01 and MICP1 received rank 02 in *Yala* 2015 season. . Based on the *Maha* 2015/16 result, again ANKCP 02 received rank 02 and ANKCP 01 received rank 01.

Table 1. Mean yield of the cowpea breeding lines/varieties at GLORDC in PYT of *Maha* 2013/14 and MYT during *Yala* 2014

Variety/line(s)	PYT Yield (kg/ha) (<i>Maha</i> 2013/14)	MYT Yield (kg/ha) (<i>Yala</i> 2014)
1935-1	*1653 ^{ab}	1171 ^{bc}
ANKCP 02	1780 ^a	1810 ^a
1935-3	1353 ^{abc}	1002 ^{bcd}
Ar22-1	1025 ^{bc}	989 ^{bcd}
Dhwa-1	991 ^{bc}	864 ^{bcd}
2021-1	1137 ^{abc}	1130 ^{bc}
2021-2	1448 ^{abc}	1220 ^{bc}
2021-3	982 ^{bc}	1124 ^{bc}
2021-4	953 ^c	1153 ^{bc}
2021-5	1430 ^{abc}	1189 ^{bc}
2021-6	1201 ^{abc}	812 ^{bcd}
2021-7	955 ^c	470 ^{cd}
2021-8	1533 ^{abc}	1540 ^b
2021-9	963 ^c	989 ^{bcd}
MICP1 (check.1)	1480 ^{abc}	1288 ^{bc}
Waruni (check.2)	1497 ^{abc}	1417 ^b
LSD	450	520
CV%	18	15

*Within the column, the mean yield followed by the same letter are not significantly different at $p=0.05$

Variety Adaptability Trial (VAT)

Yield performances at farmers' field conditions evaluated by variance component method of the selected varieties are presented in Tables 4. According to the ranking based on variance component method ANKCP 01 received rank 01 and ANKCP 02 received rank 02 during *Maha* 2015/16 season. In *Yala* 2016 season ANKCP 02 received rank 01 and ANKCP 01 received rank 02.

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Table 2. Mean yield and mean ranks of the cowpea breeding lines/varieties based on ranking method in NCVT locations during *Maha* 2014/15, *Yala* 2015 and *Maha* 2015/16 seasons

Season	Variety/line	Locations					Mean rank
		ANK t/ha	AWL t/ha	MI t/ha	WWL t/ha	TNW t/ha	
<i>Maha</i> 2014/15	ANKCP2	0.72 ^{a*}	0.22 ^b	1.26 ^a	0.56 ^a	2.24 ^a	4.8
	ANKCH2	0.59 ^b	0.34 ^a	0.93 ^{ab}	0.27 ^b	1.92 ^c	4.1
	ANKCH3	0.64 ^b	0.33 ^a	0.28 ^b	0.22 ^b	1.17 ^e	3.6
	WARUNI	0.71 ^a	0.35 ^a	1.59 ^a	0.26 ^b	2.14 ^b	4.6
	MICP1	0.71 ^a	0.380 ^a	0.87 ^{ab}	0.51 ^a	1.28 ^d	4.3
	CV	4.2	9.5	49	19	3	
	LSD	54	59	920	173	24	
<i>Yala</i> 2015	ANKCP2	1.63 ^a	2.05 ^a	2.45 ^a	2.38 ^a	0.40 ^b	4.8
	ANKCH2	1.63 ^a	1.18 ^b	1.55 ^b	2.49 ^a	0.32 ^b	4.4
	ANKCH3	1.17 ^a	1.49 ^{ab}	2.10 ^{ab}	2.48 ^a	0.82 ^a	4.8
	WARUNI	1.25 ^a	1.35 ^{ab}	2.07 ^{ab}	2.71 ^a	-	4.75
	ANKCP1	1.72 ^a	1.49 ^{ab}	1.65 ^b	2.33 ^a	1.06 ^a	4.7
	MICP1	1.26 ^a	1.10 ^b	2.01 ^{ab}	2.47 ^a	0.39 ^b	4.5
	CV%	24	22	20	19	26	
LSD	416	852	725	276	310		
<i>Maha</i> 2015/16	ANKCP2	1.52 ^a	2.38 ^a	2.25 ^{ab}	2.42 ^a	-	6
	ANKCH2	0.73 ^{ab}	1.91 ^{ab}	1.86 ^{ab}	1.97 ^a	-	5.7
	ANKCH3	1.57 ^a	1.87 ^{ab}	1.56 ^b	2.04 ^a	-	5.5
	WARUNI	1.15 ^a ^b	1.87 ^{ab}	2.85 ^a	2.3 ^a	-	5.6
	ANKCP1	1.49 ^a	1.47 ^b	2.36 ^{ab}	2.55 ^a	-	5.5
	MICP1	0.47 ^b	1.65 ^{ab}	2.45 ^{ab}	2.25 ^a	-	5.4
	CV%	25.91	20.96	23.82	23.89	-	6
LSD	430	340	350	345	-	5.7	

* Within the column, the means followed by the same letter are not significantly different at $p=0.05$

ANK = Angunakolapellessa AWL = Aralaganwila MI = Maha-Illuppallama WWL = Weerawila
TNW = Thirunelweli

Table 03. Adaptability parameters derived using Variance Component Method in NCVT locations during *Maha* 2014/15, *Yala* 2015 and *Maha* 2015/16

Season	Entry	Average grain yield over locations (t/ha)	No. of positive deviations out of 5	Adaptability parameter		
				Mean deviation over locations	Interaction variance	Adaptability rank
<i>Maha</i> 2014/15	ANKCP2	1.01	2	0.16198	0.015979	2
	ANKCH2	0.82	1	-0.0958	0.001704	3
	ANKCH3	0.37	2	-0.2226	0.020095	5
	ANKCP1	1.02	2	0.17266	0.023146	1
	MICP1	0.75	2	-0.14812	0.015049	4
<i>Yala</i> 2015	ANKCP2	2.14	2	0.3422	0.036009	1
	ANKCH2	1.72	1	-0.1334	0.021808	6
	ANKCH3	1.82	2	-0.0340	0.013272	4
	WARUN	2.05	2	0.0005	0.012991	3
	ANKCP1	1.80	1	-0.0470	0.022041	5
	MICP1	1.72	2	0.0214	0.016032	2
<i>Maha</i> 2015/16	ANKCP2	1.79	4	0.0747	0.5672	2
	ANKCH2	1.71	2	-0.0343	0.7848	6
	ANKCH3	1.67	2	-0.1393	0.3961	4
	Waruni	1.73	1	-0.0592	0.4278	5
	ANKCP1	1.84	4	0.1260	0.2461	1
	MICP1	1.76	3	0.0136	0.2596	3

Yield performances of large scale farmer's fields for fresh pod yield and dry seed yield were evaluated in 12 locations in major cowpea growing areas. Average fresh pod yield was 6,500 kg/ha and dry seed yield was 1,600 kg/ha (data not shown).

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Table 4. Mean yield and the adaptability ranks of tested varieties in VAT during *Maha* 2015/16 and *Yala* 2016

Season	Lines	Distance from Maximum respons		Average yield t/ha	Adaptability rank
		Mean	Variance		
<i>Maha</i> 2015/16	ANKCP2	0.25 ^{c*}	0.073	1.51	2
	IT 499	0.9 ^a	0.113	0.91	4
	MICP1	0.5 ^b	0.340	1.26	3
	ANKCP1	0.25 ^c	0.140	1.59	1
<i>Yala</i> 2016	ANKCP2	0.19 ^b	0.062	1.69	1
	IT 499	0.68 ^a	0.348	1.20	4
	MICP1	0.59 ^a	0.272	1.29	3
	ANKCP1	0.49 ^a	0.132	1.39	2

* Within the column, the means followed by the same letter are not significantly different at $p=0.05$

Other agronomic characters of the variety

There were two distinguished groups according to the analysis of variance for the days to flowering. ANKCP 02 belongs to early flowering group along with the Waruni, MICP1 and MI 35. For the maturity characteristic also ANKCP 02 showed similar results with the early maturing varieties Waruni, Dhawala and MI 35. The variety exhibited a determinate growth habit with moderate number of pods per plant compared to recommended check varieties. The variety ANKCP 02 contains 14 seed per pod and the 100 seed weight was also higher compared to all other varieties tested.

Table 6. Other important agronomic characters and yield components of the cowpea lines/ varieties at Grain Legumes and Oil Crops Research and Development Center (GLORD), Angunakolapellassa in during Maha 2015/16

Variety	Days to 50% flowering	Days to maturity	Plant Height at maturity (cm)	Growth habit	Pods/ plant	Seeds/ pod	100 seed weight (g)
ANKCP2	*44 ^b	57 ^b	65.8	D	16	14	21
ANKCH 2	51 ^a	60 ^a	67.4	D	13	14	13
ANKCH 3	51 ^a	62 ^a	78	D	12	11	15
ANKCP01	44 ^b	61 ^a	82	D	16	12	15
Waruni (std)	44 ^b	54 ^c	53	D	13	12	12
MICP1 (std)	43 ^b	57 ^b	67	D	16	16	14
CV%	5.1	9.1	-	-	-	-	-
LSD	4.2	6.1	-	-	-	-	-

D=Determinate

**Within the column, the medians followed by the same letter are not significantly different at $p=0.05$.*

Sensory characteristics of boiled cowpea

Sensory attributes such as colour, texture, taste, seed size and aroma were evaluated by using 5- point hedonic ranking test, and it was not significantly different among the tested varieties. However, ANKCP 02 was the most preferred boiled cowpea variety among the tested samples while ANKCP 01 and Bombay was the second place.

In addition, majority (70%) of the farmers who involved in the VAT and LSVAT preferred ANKCP 02 than the other check varieties due to the superior plant structure and seed characters (seed size, shape and the attractive seed coat color). The ability to obtain 70% of the harvest from the first pick also one of the reasons for higher preference of the new line/variety among the farmers. Farmers prefer to use this variety as dual purpose cowpea as well. Because harvested immature fresh pod's seed used to prepare curry and dry seed used as breakfast meal after boiling. With the rain or under irrigated condition, this variety can produce 3-4 picks providing considerable yield during both *Yala* and *Maha* seasons.

CONCLUSIONS

The new variety ANKCP 02 displays high yield potential and its yields are highly adaptable and stable. It has a vigorous plant structure and attractive seed coat color. ANKCP 02 can yield more than 1,400 kg/ha in both *Yala* and *Maha* seasons. Further, the new variety provides grain harvest as fresh pod seed and dry seed. The new variety was preferred by farmers due to high seed quality, cooking qualities and the taste. Therefore, the tested new variety ANKCP 02 was recommended by the varietal release committee of Department of Agriculture for cultivation in cowpea growing areas of Sri Lanka in 2017.

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