Available online at http://scik.org
Adv. Fixed Point Theory, 5 (2015), No. 4, 396-406
ISSN: 1927-6303

A COMMON FIXED POINT THEOREM OF PRESIC TYPE FOR FOUR MAPS IN G-METRIC SPACES

U. C. GAIROLA[1], N. DHASMANA[2,*]

Department of Mathematics, H. N. B. Garhwal University, Campus Pauri,
Pauri Garhwal- 246001, Uttarakhand India

Abstract. In this paper, we extended the idea of Presic type contraction for G-metric space to obtain a unique common fixed point result for four maps. The result generalizes several well known comparable results in the literature.

Keywords: Presic type fixed point theorem; *G*-metric space; *G*-Coincidence point; Weakly commuting, Coincidently commuting.

2010 AMS Subject Classification: 47H10, 54H25.

1. Introduction

In 1922, Banach proved a fixed point theorem for contraction mapping in metric space. This result has been extended and generalized for various settings (see, for instance [10], [12] and the references therein). The study of fixed points of mappings satisfying certain contractive condition has been at the centre of vigorous research activity. Mustafa and Sims [19] introduced the new concept of G-metric space. Since then many authors have been studying fixed point

*Corresponding author
E-mail addresses: ucgairola@rediffmail.com (U. Gairola), nirmaladhasmana@rediffmail.com (N. Dhasmana)
Received May 16, 2015

results in G-metric spaces and subsequently many fixed point results on such spaces appeared (see, for instance [1-6], [8], [18], [20-21], [27] and the references therein).

On the other hand, amongst the various generalization of Banach contraction principle, Presic [22] in 1965 gave a contractive condition on finite product of metric spaces and proved a fixed point theorem. Further Ciric- Presic [9], Gairola-Rawat [14], George - Khan [17] and Rao et. al. [23-24] extended and generalized these results. Also with a view to generalize the fixed point theorem for commuting maps, Sessa [25] introduced the concepts of weakly commuting maps. Later on, Singh and Gairola [26] extended the notion of weakly commuting maps to co-ordinatewise commuting and weakly commuting maps for two system of maps on finite product of metric spaces and proved some fixed point theorems. Gairola and Jangwan [15], Singh Gairola and [16] and Baillon and Singh [7] conceptualize co-ordinatewise R-weakly commuting mappings and compatible maps. George and Khan [17] used the concept of weakly commuting and coincidently commuting maps for k-tuples and generalized Presic type fixed point theorem for two maps and then later on Rao *et al.* [23] extended this work for three maps using the concept of 2k-weakly compatible pair.

The aim of this paper is to prove a Presic type common fixed point theorem for four mappings in complete G-metric space which extend and unify the results of Ciric-Presic [9], Dhasmana [11], Gairola-Dhasmana [13] and Rao *et al.* [23].

2. Definitions and propositions

We begin by briefly recalling some basic definitions and results will be needed in the sequel. Let (X,d) be a metric space, k a positive integer, $T : X^k \to X$ and $f : X \to X$ be mappings. An element $x \in X$ is said be a coincidence point of f and T if $fx = T(x,x,.....,x)$, x is a common fixed point of f and T if $x = fx = T(x,x.....,x)$. The set of coincidence point of f and T is denoted by $C(f,T)$.

Definition 2.1. [17] (see also [26]) Mappings f and T are said to be commuting if $f(T(x,x....,x)) = T(fx, fx,....,fx)$ for all $x \in X$.

Definition 2.2. [17] (see also [26]) Mappings f and T are said to be weakly commuting if $d(f(T(x,x,....,x)),T(fx, fx,....,fx)) \leq d(f(x),T(x,x,...,x))$ for all $x \in X$.

Definition 2.3. [17] Mappings f and T are said to be coincidentally commuting if they commute at their coincidence points.

Remark 2.4. [17] (see also [26]) For $k=1$, above definitions reduce to the usual definition of commuting and weakly commuting mappings in a metric space.

Remark 2.5. It is notable that the above Definitions 2.1, 2.2 and 2.3 are special cases of definition 1 and 2 of Singh-Gairola [26]. See also the remarks of Gairola *et al.* [15-16].

Definition 2.6. [19] Let X be a nonempty set, and let $G : X\times X\times X \to \mathbb{R}^+$, be a function satisfying:

$(G_1) G(x,y,z)=0$; if $x=y=z$,

$(G_2) 0<G(x,x,y)$; for all $x,y\in X$ with $x\neq y$

$(G_3) G(x,x,y)\leq G(x,y,z)$; for all $x,y,z\in X$ with $z\neq y$.

$(G_4) G(x,y,z)=G(x,z,y)=G(y,z,x)=....$; (symmetry in all three variables) and

$(G_5) G(x,y,z)\leq G(x,a,a)+G(a,y,z)$ for all $x,y,z,a\in X$ (rectangle inequality).

Then the function G is called a generalized metric or more specifically a G-metric on X, and the pair (X,G) is called a G-metric space.

Definition 2.7. [19] Let (X,G) be a G-metric space and let $\{x_n\}$ be a sequence of points of X. We say that $\{x_n\}$ is G-convergent to x if $lim_{n,m\to\infty} G(x,x_n,x_m)=0$; that is, for any $\varepsilon>0$, there exists $N\in\mathbb{N}$ such that $G(x,x_n,x_m)<\varepsilon$, for all $n,m\geq N$. We refer to x as the limit of the sequence $\{x_n\}$ and write $x_n \xrightarrow{G} x$.

Proposition 2.8. [19] *Let (X,G) be a G-metric space. The following statements are equivalent.*

(1) $\{x_n\}$ is G-convergent to x.

(2) $G(x_n,x_n,x)\to 0$, as $n\to\infty$.

(3) $G(x_n,x,x)\to 0$, as $n\to\infty$.

Definition 2.9. [19] Let (X,G) be a G-metric space. A sequence $\{x_n\}$ is called G-Cauchy if given $\varepsilon>0$, there is $N\in\mathbb{N}$ such that $G(x_n,x_m,x_l)<\varepsilon$, for all $n,m,l\geq N$, that is, if $G(x_n,x_m,x_l)\to 0$, as $n,m,l\to\infty$.

Proposition 2.10. [19] *In a G-metric space (X,G), the following two statements are equivalent.*
(1) The sequence $\{x_n\}$ is G-Cauchy.
(2) For every $\varepsilon > 0$, there exists $N \in \mathbb{N}$ such that $G(x_n,x_m,x_m) < \varepsilon$ for all $n,m \geq N$.

Definition 2.11. [19] A G-metric space (X,G) is said to be G-complete (or a complete G-metric space) if every G-Cauchy sequence in (X,G) is G-convergent in (X,G).

Definition 2.12. [19] A G-metric space (X,G) is called symmetric if $G(x,y,y) = G(y,x,x)$ for all $x,y \in X$.

Proposition 2.13. [19] *Let (X,G) be a G-metric space. Then the function $G(x,y,z)$ is jointly continuous in all three of its variables.*

Proposition 2.14. [19] *Every G-metric space (X,G) defines a metric space (X,d_G) by*
$d_G(x,y) = G(x,y,y)+G(y,x,x)$ for all $x,y \in X$.
Note that if (X,G) is a symmetric G-metric space, then
$d_G(x,y) = 2G(x,y,y)\ \forall x,y \in X$.

3. Main results

Now we state our main result.

Theorem 3.1. *Let (X,G) be a G-metric space, k a positive integer and $S,T,R : X^k \to X$, $f : X \to X$ be mappings satisfying the following conditions*

(1) $$S(X^k) \cup T(X^k) \cup R(X^k) \subseteq f(X)$$

(2) $$\begin{aligned} & G(S(x_1,x_2,....,x_{k-1},x_k),T(x_2,x_3,....,x_k,x_{k+1}), \\ R(x_3,x_4,...,x_{k+1},x_{k+2})) \quad & \leq \quad \lambda max\{G(fx_i,fx_{i+1},fx_{i+2}),1 \leq i \leq k\} \\ & for \ \ all \ \ x_1,x_2,...,x_k,x_{k+1},x_{k+2} \ \ in \ \ X \end{aligned}$$

(3) $$\begin{aligned} & G(T(y_1,y_2,...,y_{k-1},y_k),R(y_2,y_3,....,y_k,y_{k+1}), \\ S(y_3,y_4,...,y_{k+1},y_{k+2})) \quad & \leq \quad \lambda max\{G(fy_i,fy_{i+1},fy_{i+2}),1 \leq i \leq k\} \end{aligned}$$

$$for\ \ all\ \ y_1,y_2,...,y_k,y_{k+1},y_{k+2}\ \ in\ \ X$$

(4) $$G(R(z_1,z_2,...,z_{k-1},z_k),S(z_2,z_3,....,z_k,z_{k+1}),$$

$$T(z_3,z_4,...,z_{k+1},z_{k+2})) \leq \lambda max\{G(fz_i,fz_{i+1},fz_{i+2}),1 \leq i \leq k\}$$

$$for\ \ all\ \ z_1,z_2,...,z_k,z_{k+1},z_{k+2}\ \ in\ \ X, where\ \ 0 \leq \lambda < 1,$$

(5) $$d\Big(\ S(u,u,...u),T(v,v,...v),R(w,w,....w)\ \Big) < G(fu,fv,fw),$$

for all $u,v,w \in X$ with $u \neq v \neq w$. Suppose that $f(X)$ is complete and one of $(f,S),(f,T)or(f,R)$ is coincidently commuting pair. Then there exist a unique point $p \in X$ such that $fp = p = S(p,p,...,p) = T(p,p,...,p) = R(p,p,....,p)$.

Proof. Suppose $x_1,x_2,....,x_k$ are arbitrary points in X and for $n \in N$ and define

$$\begin{aligned} fx_{k+3n-2} &= S(x_{3n-2},x_{3n-1},....,x_{3n+k-3}), \\ fx_{k+3n-1} &= T(x_{3n-1},x_{3n},...,x_{3n+k-2}), \\ fx_{k+3n} &= R(x_{3n},x_{3n+1},...,x_{3n+k-1}). \end{aligned}$$

Let

(6) $$\alpha_n = G(fx_n,fx_{n+1},fx_{n+2}).$$

Let $\theta = \lambda^{\frac{1}{k}}$ and $K = max\{\frac{\alpha_1}{\theta^1},\frac{\alpha_2}{\theta^2},....,\frac{\alpha_k}{\theta^k}\}$. Claim $\alpha_n \leq K\theta^n$ for all $n \in N$. By selection of K we have $\alpha_n \leq K\theta^n$ for $n = 1,2,....,k$. Now,

$$\begin{aligned} \alpha_{k+1} &= G(fx_{k+1},fx_{k+2},fx_{k+3}) \\ &= G(S(x_1,x_2,...,x_k),T(x_2,x_3,....,x_{k+1}),R(x_3,x_4,...,x_{k+2})) \\ &\leq \lambda max\{G(fx_i,fx_{i+1},fx_{i+2}) : i = 1,2,....k\}\ \ by\ \ (2) \\ &= \lambda max\{\alpha_1,\alpha_2,....,\alpha_{k-1},\alpha_k\} \\ &\leq \lambda max\{K\theta^1,K\theta^2,...,K\theta^{k-1},K\theta^k\} \\ &= \lambda K\theta = \theta^k K\theta\ \ as\ \ \theta = \lambda^{\frac{1}{k}}. \end{aligned}$$

Thus $\alpha_{k+1} \leq K\theta^{k+1}$. Similarly, we have

$$\begin{aligned}
\alpha_{k+2} &= G(fx_{k+2}, fx_{k+3}, fx_{k+4}) \\
&= G(T(x_2, x_3, ..., x_{k+1}), R(x_3, x_4, ..., x_{k+2}), S(x_4, x_5, ..., x_{k+3})) \\
&\leq \lambda max\{G(fx_i, fx_{i+1}, fx_{i+2}) : i = 2, 3....k+1\} \;\; by \;\; (3) \\
&= \lambda max\{\alpha_2, \alpha_3, ..., \alpha_k, \alpha_{k+1}\} \\
&\leq \lambda max\{K\theta^2, K\theta^3, ..., K\theta^k, K\theta^{k+1}\} \\
&= \lambda K\theta^2 = \theta^k K\theta^2 \;\; as \;\; \theta = \lambda^{\frac{1}{k}} = K\theta^{k+2}.
\end{aligned}$$

Thus $\alpha_{k+2} \leq K\theta^{k+2}$. Also,

$$\begin{aligned}
\alpha_{k+3} &= G(fx_{k+3}, fx_{k+4}, fx_{k+5}) \\
&= G(R(x_3, x_4, ..., x_{k+2}), S(x_4, x_5, ..., x_{k+3}), T(x_5, x_6, ..., x_{k+4})) \\
&\leq \lambda max\{G(fx_i, fx_{i+1}, fx_{i+2}) : i = 3, 4....k+2\} \;\; by \;\; (4) \\
&= \lambda max\{\alpha_3, \alpha_4, ..., \alpha_{k+1}, \alpha_{k+2}\} \\
&\leq \lambda max\{K\theta^3, K\theta^4, ..., K\theta^{k+1}, K\theta^{k+2}\} \\
&= \lambda K\theta^3 = \theta^k K\theta^3 \;\; as \;\; \theta = \lambda^{\frac{1}{k}} = K\theta^{k+3}.
\end{aligned}$$

Thus $\alpha_{k+3} \leq K\theta^{k+3}$. Hence the claim is true.

Now, by claim, for l, n, p with $l > n > p$ and the recangular inequality of G-metric space, we have

$$\begin{aligned}
G(fx_n, fx_p, fx_l) &\leq G(fx_n, fx_{n+1}, fx_{n+1}) + G(fx_{n+1}, fx_{n+2}, fx_{n+2}) + ... + G(fx_{l-1}, fx_l, fx_l) \\
&\leq G(fx_n, fx_{n+1}, fx_{n+2}) + G(fx_{n+1}, fx_{n+2}, fx_{n+3}) + ... + G(fx_{l-2}, fx_{l-1}, fx_l) \\
&= \alpha_n + \alpha_{n+1} + ... + \alpha_{l-2} \\
&\leq K\theta^n + K\theta^{n+1} + ... + K\theta^{l-2} \\
&\leq K[\theta^n + \theta^{n+1} + ... + \theta^{l-2} + ..] \\
&= K\frac{\theta^n}{1-\theta} \to 0 \;\; as \;\; n \to \infty.
\end{aligned}$$

Hence $\{fx_n\}$ is a G-Cauchy sequence. Since $f(X)$ is a G-complete and there exists z in $f(X)$ such that $z = lim fx_n$. There exist $p \in X$ such that $z = fp$. Then for any integer n, using (2), (3) and (4) we have

$$
\begin{aligned}
&G(S(p,p,...,p), fx_{k+3n-2}, fx_{k+3n-2}) \\
&= G\Big(S(p,p,...,p), S(x_{3n-2},x_{3n-1},...,x_{k+3n-3}), S(x_{3n-2},x_{3n-1},...,x_{k+3n-3}) \Big) \\
&\leq G\Big(S(p,p,...,p), T(p,p,...,x_{3n-2}), T(p,p,...,x_{3n-2}) \Big) \\
&+ G\Big(T(p,p,...,x_{3n-2}), R(p,p,...,x_{3n-1}), R(p,p,...,x_{3n-1}) \Big) \\
&+ G\Big(R(p,p,...,x_{3n-1}, S(p,p,..,x_{3n}), S(p,p,...,x_{3n}) \Big) \\
&+ G\Big(S(p,p,..,x_{3n}), T(p,p,...,x_{3n+1}), T(p,p,...,x_{3n+1}) \Big) \\
&+ ... \\
&+ G\Big(T(p,p,x_{3n-2},...,x_{k+3n-5}), R(p,x_{3n-2},...,x_{k+3n-4}), R(p,x_{3n-2},...,x_{k+3n-4}) \Big) \\
&+ G\Big(R(p,x_{3n-2},...,x_{k+3n-4}), S(x_{3n-2},...,x_{k+3n-3}), S(x_{3n-2},...x_{k+3n-3}) \Big) \\
&\leq G\Big(S(p,p,...,p), T(p,p,...,x_{3n-2}), R(p,p,..,x_{3n-1}) \Big) \\
&+ G\Big(T(p,p...,x_{3n-2}), R(p,p,...,x_{3n-1}), S(p,p,...,x_{3n}) \Big) \\
&+ G\Big(R(p,p,...,x_{3n-1}), S(p,p,...,x_{3n}), T(p,p,...,x_{3n+1}) \Big) \\
&+ G\Big(S(p,p,..,x_{3n}), T(p,p,...,x_{3n+1}), R(p,p,...,x_{3n+2}) \Big) \\
&+ ... \\
&+ G\Big(S(p,p,...,x_{k+3n-6}), T(p,p,...,x_{k+3n-5}), R(p,x_{3n-2},...,x_{k+3n-4}) \Big) \\
&+ G\Big(T(p,p,x_{3n-2},..,x_{k+3n-5}), R(p,x_{3n-2},..,x_{k+3n-4}), S(x_{3n-2},...,x_{k+3n-3}) \Big) \\
&\leq \lambda G(fp, fx_{3n-2}, fx_{3n-1}) \\
&+ \lambda max\{G(fp, fx_{3n-2}, fx_{3n-1}), G(fx_{3n-2}, fx_{3n-1}, fx_{3n})\} \\
&+ \lambda max\{G(fp, fx_{3n-2}, fx_{3n-1}), G(fx_{3n-2}, fx_{3n-1}, fx_{3n}), G(fx_{3n-1}, fx_{3n}, fx_{3n+1})\}
\end{aligned}
$$

$$
\begin{aligned}
&+ \quad \lambda max\{G(fp, fx_{3n-2}, fx_{3n-1}), G(fx_{3n-2}, fx_{3n-1}, fx_{3n}), ..., G(fx_{3n}, fx_{3n+1}, fx_{3n+2})\} \\
&+ \quad ... \\
&+ \quad \lambda max\{G(fp, fx_{3n-2}, fx_{3n-1}), ..., G(fx_{k+3n-6}, fx_{k+3n-5}, fx_{k+3n-4})\} \\
&+ \quad \lambda \ max\{G(fp, fx_{3n-2}, fx_{3n-1}), ..., G(fx_{k+3n-5}, fx_{k+3n-4}, fx_{k+3n-3})\}.
\end{aligned}
$$

Taking limit as $n \to \infty$, we get $G(S(p, p, ..., p), fp, fp) \leq 0$ so that

$$S(p, p, ..., p) = fp. \tag{7}$$

Consider,

$$G(fp, T(p, p, .., p), T(p, p, ..., p)) = G(S(p, p, .., p), T(p, p, ..., p), T(p, p, ..., p)) \leq \lambda(0) = 0.$$

Thus

$$T(p, p, .., p) = fp. \tag{8}$$

Also

$$G(fp, R(p, p, ..., p), R(p, p, ..., p)) = G(T(p, p, ..., p), R(p, p, ..., p), R(p, p, ..., p)) \leq \lambda(0) = 0.$$

Thus

$$R(p, p, ..., p) = fp. \tag{9}$$

Now suppose that (f, S) is a coincidentally commuting pair. Then we have

$$f(S(p, p, ..., p)) = S(fp, fp, ..., fp),$$

$$f^2 p = f(f(p)) = f(S(p, p, .., p)) = S(fp, fp, ..., fp).$$

Suppose $fp \neq p$

$$G(f^2 p, fp, fp) = G(S(fp, fp, ..., fp), T(p, p, .., p), R(p, p, ..., p)) < d(f^2 p, fp, fp).$$

It is a contradiction. Therefore $fp = p$. Now from (7), (8) and (9) we have

$$fp = p = S(p, p, ..., p) = T(p, p, ...p) = R(p, p, ..., p).$$

Uniqueness of p: Suppose there exists a point $q \neq p$ in X such that

$$fq = q = S(q,q,...,q) = T(q,q,...,q) = R(q,q,...,q).$$

Consider from (5)

$$G(fp, fq, fq) = G(S(p,p,...,p), T(q,q,...,q), R(q,q,...,q)) < G(fp, fq, fq).$$

It is a contradiction. Therefore $q = p$.

Now we can get the following result of Gairola-Dhasmana [13] as a corollary.

Corollary 3.2. *Let (X,G) be a G-metric space, k a positive integer and $T: X^k \to X, f: X \to X$ be mappings satisfying the following conditions*

$$T(X^k) \subseteq f(X) \tag{10}$$

$$G(T(x_1,x_2,....,x_{k-1},x_k), T(x_2,x_3,....,x_k,x_{k+1}), \tag{11}$$

$$T(x_3,x_4,...,x_{k+1},x_{k+2})) \leq \lambda max\{G(fx_i, fx_{i+1}, fx_{i+2}), 1 \leq i \leq k\}$$

$$for \ \ all \ x_1,x_2,...,x_k,x_{k+1},x_{k+2} \ \ in \ \ X$$

$$G\Big(\ T(u,u,...u), T(v,v,...v), T(w,w,....w) \ \Big) \ < \ G(fu, fv, fw), \tag{12}$$

for all $u,v,w \in X$ with $u \neq v \neq w$. Suppose that $f(X)$ is G-complete and (f,T) is coincidently commuting pair. Then there exist a unique point $p \in X$ such that $fp = p = T(p,p,...,p)$.

Proof. Putting $S = R = I$ (Identity map) in Theorem 3.1 we can get the required proof.

Remark 3.3. If $f = I$ (Identity map) in Corollary 3.2, we get the main Theorem of [11].

Conflict of Interests

The authors declare that there is no conflict of interests.

REFERENCES

[1] M. Abbas, T. Nazir, P. Vetro, Common fixed point results for three maps in G-metric spaces, Filomat 25 (2011), 1-17.

[2] M. Abbas, B. E. Rhoades, Common fixed points results for non-commuting mappings without continuity in generalized metric spaces, Appl. Math. Comput. 215 (2009), 262-269.

[3] R. Agarwal, E. Karapinar, Remarks on some coupled fixed point theorems in G-metric spaces, Fixed Point Theory Appl. 2013 (2013), Article ID 2.

[4] H. Aydi, W. Shatanawi and C. Vetro, On generalized weak G-contraction mapping in G-metric spaces Comput. Math. Appl. 62 (2011), 4223-4229.

[5] H. Aydi, E. Karapinar, Z. Mustafa, On common fixed points in G-metric spaces using (E.A.) property Comput. Math. Appl. 64 (2012), 1944-1956.

[6] A. Azam, M. Arshad, Kannan fixed point theorem on generalized metric spaces, J. Nonlinear Sci. Appl. 1 2008), 45-48.

[7] J. B. Baillon, S. L. Singh, Nonlinear hybrid contractions on product spaces, Far East. J. Math. Sci. 1 (1993), 117-127.

[8] B. S. Choudhury, P. Maity, Coupled fixed point results in generalized metric spaces, Math. Comput. Model. 54 (2011), 73-79.

[9] Lj. B. Ciric, S. B. Presic, Presic type generalization of the Banach Contraction Mapping principle, Acta. Math. Univ. Comenianae, LXXVI (2007), 143-147.

[10] B. C. Dhage, Generalized metric space and mMappings with fixed point, Bull. Calcutta Math. Soci. 84 (1992), 329-336.

[11] Nirmala Dhasmana, A fixed point theorem for Presic type in G-metric spaces, Int. J. Math. Archive 6((2015), 11-14.

[12] S. Gahler, 2-metrices raume und Ihre topologische struktur, Math. Nach. 26 (1963), 115-148.

[13] U. C. Gairola, Nirmala Dhasmana, A fixed point theorem of Presic type for a pair of maps in G-metric space, Internat. J. Math. Archive 6 (2015), 196-200.

[14] U. C. Gairola, A. S. Rawat, A fixed point theorem for a finite product of metric spaces, J. Mountain Res. 4 (2009), 77-82.

[15] U. C. Gairola, P. S. Jangwan, Co-ordinatewise R-weakly commuting mappings and fixed point theorem on product spaces, Demonstratio Math. 36 (2008), 939-949.

[16] U. C. Gairola, S. L. Singh, J. H. M. Whitfield, fixed point theorems on product of compact metric spaces, Demonstratio Math. 28 (1995), 541-548.

[17] R. George and M. S. Khan, On Presic type extension of Banach contraction principle, Internat. J. Math. Anal. 5 (2011), 1019-1024.

[18] D. Mihet, On Kannan fixed point principle in generalized metric spaces, J. Nonlinear Sci. Appl. 2 (2009), 92-96.

[19] Z. Mustafa, B. Sims, A new approach to generalized metric spaces, J. Nonlinear Convex Anal. 7 (2006), 289-297.

[20] Z. Mustafa, M. Khandaqji, W. Shatanawi, Fixed point results on complete G-metric spaces, Studia Sci. Math. Hung. 48 (2011), 304-319.

[21] Z. Mustafa, W. Shatanawi, M. Bataineh, Existence of fixed point results in G-metric spaces, Internat. J. Math. Math. Sci. 2009 (2009), Article ID 283028.

[22] S. B. Presic, "Sur une classe dinequations aux dufferences finite et sur la convergence de certains suites," Publications de I'Institut Mathematique, 5 (1965), 75-78.

[23] K. P. R. Rao, G. N. V. Kishore, Md. Mushtaq Ali, Generalization of Banach contraction principle of presic type for three maps, Math. Sci. 3 (2009), 273-280.

[24] K. P. R. Rao, Md. Mushtaq Ali, B. Fisher,Some Presic type generalization of Banach contraction principle, Math. Moravic. 15 (2011),41-47.

[25] S, Sessa, On weakly commutativity condition in fixed point considerations, Publ. Inst. Math. (Beogard), 32 (1982), 149-153.

[26] S. L. Singh, U. C. Gairola, A general fixed point theorem, Math. Japanica 36 (1991), 91-108.

[27] W. Shatanawi, Some fixed point theorems in ordered G-metric spaces and applications Abstr. Appl. Anal. 2011 (2011), Article ID 126205.